THE

ELECTRICAL REVIEW.

VOL. XLIII. JULY 22, 1898. No. 1,078.

CONTENTS:

	PAGE
Exit Marylebone	105
Metallic Resistances (*continued*)	107
The Development of the Central Station	108
Legal:—Castner-Kellner Company *v.* Commercial Development Corporation	109
Weblyn *v.* Shoolbred	112
Action against the Corporation of Worcester	114
Arnold & Co. *v.* Goossens, Pope & Co.	114
Donnelly *v.* Egan & Son, Limited	115
Brown *v.* Edinburgh Corporation	115
Correspondence:—Arc Lighting	115
Induction on Telephone Circuits	115
Electricity in Italy	115
Business Notices, &c.	115
The Blackpool and Fleetwood Electric Tramways (*illustrated*)	123
Power Distribution in Factories	125
Notes	128
City Notes	130
Traffic Receipts	134
Share List of Electrical Companies	135
The Municipal Electrical Association:—The Use of Accumulators in Connection with Lighting and Traction Systems (*illustrated*)	136
Parliamentary	138
Electric Lighting Provisional Orders (*continued*)	138
The Telephone Inquiry (*continued*)	139
The London County Council	142
The Chemistry of Boiler Waters	142
Reviews:—Acetylene Gas, Its Nature, Properties and Uses; also Calcium Carbide, Its Composition, Properties and Method of Manufacture	142
Steam Boiler Construction.—Industrial Electricity	143
Magnetic Susceptibility of Materials	144
New Patents	144

THE

UNIVERSAL ELECTRICAL DIRECTORY

1898

Edition

Price 6s.

H. ALABASTER, GATEHOUSE & CO.

4, LUDGATE HILL, LONDON, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "AGENRAY, LONDON." Code A B C.

Telephone No. 988 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 4s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES,—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s. or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 23, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4 Ludgate Hill E.C.

EXIT MARYLEBONE.

THE decision arrived at last week by a House of Commons Committee, that sanction should be refused to the provisional order applied for by the Marylebone Vestry, is perhaps the most momentous in its bearing on the electrical industry that has been arrived at since the passing of the Electric Lighting Act, 1888. It certainly is the most momentous since the issue of Major Marindin's Report of 1889, which settled the principle upon which electricity supply in London should be carried out.

It will be remembered that in 1889, the first year after the enactment of the Electric Lighting Act of 1888, there was a rush of undertakers who desired to appropriate the rich prize which the lighting of the metropolis presented. It is perhaps true that at that time not one of the applicants realised how very rich a prize was in store for those who obtained the right of supply for the period allotted by the Electric Lighting Act of 1888, viz., 42 years, but in any case the prize was sufficiently tempting to lead to a large number of concurrent applications. In the parish of Kensington alone, we believe, applications were made by as many as five companies for provisional orders. The great number of the applications led to the appointment of the Board of Trade inquiry presided over by Sir Francis, then Major, Marindin.

The principle underlying Sir Francis's Report on that inquiry was, that as it was quite impossible to decide between the rival claims of the various applicants, justice could only be done by giving the applicants concurrent rights for the districts they applied for.

The result was, that in almost all the richest districts in London two companies were put into possession of the field with concurrent powers, though, in the case of Kensington, the parish was divided up between the applicants, each company being confined to a particular area.

We need hardly remind our readers that, under the Electric Lighting Act of 1888, it is necessary that the applicants for provisional orders should first obtain the consent of the local authority, but we venture upon the reminder in order to make quite clear the position that existed in Marylebone in 1889.

It appears that the Marylebone Vestry took a little more persuading than many other local authorities in London, and they only gave their consent to the provisional order of the Metropolitan Company upon that company consenting to enter into an agreement with them, procuring for their parish certain privileges beyond those included in the Electric Lighting Act, such as the establishing of two central stations in their district, and the power at the end of seven years of an appeal on behalf of the local authority to the Board of Trade for the revision of price.

In this agreement it was made clear that the Vestry might, if they so desired, grant a similar agreement to another company, but there was not a single intimation that the

Vestry itself might, at a later date, enter into competition with the company. As a matter of fact, we believe that the duplicate of the agreement was offered to the London Electric Supply Corporation, who, however, refused to take up a provisional order for Marylebone upon the terms which had been accepted by the Metropolitan Company.

Under this agreement, and under the provisional order granted by the Board of Trade, the Metropolitan Company have had sole occupation of Marylebone for the last 10 years, and now that electricity supply has been proved to be a good business, whether in the hands of a local authority or a company, it seems to have suggested itself to some enterprising members of the Marylebone Vestry that they should embark upon an undertaking themselves.

Under the provisional order of the Metropolitan Company, a period of 42 years from 1889 had to elapse before the Vestry had the power to purchase; but the Vestry, in view of the clause referred by us in a recent article, which wound up the first section of the Act of 1888, presumed that they could obtain concurrent powers.

The concurrent provisional order was granted by the Board of Trade, and it came before the House of Commons in due course for second reading. At the second reading it was opposed by Mr. Cripps on the ground that it was not contemplated by the Electric Lighting Act that a local authority, having once sanctioned the grant of powers to a company, should, on the expiry of sufficient time to prove whether the business was remunerative, operate a provisional order themselves without first obtaining by purchase the undertaking of the company.

The second reading was supported by the Right Honourable C. T. Ritchie, president of the Board of Trade, on the ground that the Board of Trade had no other option but to grant the order so that it might be considered by Parliament, and in due course committed to the judgment of a committee.

He finished his speech with these words: "I hope, without expressing any opinion on the merits of one party or the other, that the House will consent to refer this Bill to a Committee." The result of the division was "Ayes 198," "Noes 114," the majority for the second reading of the Bill being 94.

We believe we are right in stating that this majority was largely secured by the action of the Association of Municipal Corporations, who sent out a special whip to the Town Clerks in the kingdom calling upon them to bring pressure upon the members of their boroughs to support the Bill on the ground that a local authority should be supported in its endeavour to carry out the electric lighting of its district even with a company in possession. In sending out this whip we think the Association of Municipal Corporations made a mistake, because it appears to us that the true principle is that the holders of a provisional order, whether they be local authority or a company, fulfilling their obligation to the letter, should be allowed to have peaceable possession. However, the Bill went "upstairs," and was duly considered by a Committee last week.

Mr. Hammond, who appears to have made himself champion of the doctrine of "peaceable possession the reward of good behaviour," gave strong evidence against the Bill, and stated before the Committee that the large capital at present invested by local authorities and by companies in provisional orders for the supply of electric light throughout the kingdom has been contributed on the basis of security of tenure, and that if that security of tenure was taken away there would be a great blow given to the further development of the industry.

With this doctrine we have always expressed our full conformity, and we are glad to be able to chronicle that after a short deliberation in private, the chairman of the Committee gave the following judgment:—

"In the case of the Marylebone order we find that the provisional order should not be confirmed. In the Bermondsey case we suggest that the order should be withdrawn, as the point raised in it is not, in our opinion, ripe for discussion. We are of opinion that the local authority should consider the question in the light of purchase. We think that if by an original order, or by purchase, any local authority becomes the sole power for electric lighting in its district, it should not be interfered with by competition from the granting of a provisional order to any company in such district."

This decision, we are glad to be able to say, has given equal satisfaction to companies and to local authorities throughout the kingdom. Its first result has been a considerable rise in electrical securities, and it has also greatly strengthened the hands of the local authorities who are opposing the Bill of the General Power Distributing Company, who seek to obtain concurrent rights of supply in places where local authorities already hold provisional orders. This Bill, we understand, is to come up for second reading as we go to press or to-night (Friday), and if it should share the same fate as the Marylebone Bill, a very awkward episode in the industry will have passed away, and all will return to calmness once more.

We presume also that the applications for concurrent provisional orders which have recently been made to the Board of Trade will be withdrawn, and the people in possession will be allowed to carry out their good work without further interference.

Share Lists of Continental Electrical Companies.—In a recent issue of *La Revue Financière* there appears an article on the value of the shares of a number of electrical undertakings in Germany, France, and Belgium, from which it would seem that such shares are much run after by the Continental investor. Fourteen German undertakings are named, the shares of which are quoted at prices ranging from 116 to 301 per cent. of their nominal value; the highest figure being that of the shares of the Berliner Electrische Werke, which is followed by the Allgemeine Gesellschaft at 273½ per cent. and by the Schuckert Company at 256 per cent.; whilst of the remaining 11, there are six whose shares are quoted at 170 per cent. or over. In France, the company working the Thomson-Houston patents has a quotation of 283 per cent. of the nominal value of its shares, whilst the company which has the concession for the lighting of the left bank of the river at Paris follows with 160 per cent., and the Continental Edison Company with 156. In Belgium, five companies are named with quotations ranging from 130 to 198 per cent., these two prices being respectively for the ordinary and preference shares of the Société Russo-belge, whilst the shares of the Compagnie Internationale of Liége are quoted at 175 per cent., those of the Electricité de Moscow at 152 per cent., of the Electricité et Hydraulique of Charleroi at 140 per cent., and of L'Electrique at Brussels at 135 per cent. As a further proof of the way in which such investments are sought after, the journal from which these figures are taken states that new issues to the value of nearly £1,800,000 have been made this year in Germany, and that these new shares are offered to existing shareholders at premiums ranging from 10 to 42 per cent.; and a list of new issues is given which totals up to the respectable figure of £2,275,000, for which the value, including the premiums demanded, amounts to £2,976,000, or very nearly three million pounds.

METALLIC RESISTANCES.

By KILBURN SCOTT, A.I.E.E.

(*Continued from page* 72.)

"KRUPPIN" is a steel alloy, made at Essen, Germany, full particulars of which are given in Table III. It is much used on the Continent, and the makers claim that it may be raised to 600° C. without ill effects. It can be supplied from stock in 50 metre lengths, 5 mm. thick, and 10, 20, 25 or 30 mm. wide, or in sheets 1,800 mm. long, 500 mm. wide, and 0·5, 1·0 or 1·5 mm. thick.

Messrs. Brunton & Son, of Musselburgh Wire Works, Scotland, have recently introduced the "Beacon" high resistance alloy, see Table IV. This material gives a resistance about 48 times that of copper, and is therefore the highest in the market. Its temperature coefficient is ·0007007; specific gravity, 8·1; and specific resistance, 85·13 at 20° C. It has been used for some time for heating electric tramcars in America, and has shown that it does not become brittle after working for long periods at high temperatures, as so many resistance materials do. It may be supplied either hard or soft, black or plated.

Incidentally it might be mentioned these steel alloys have a slight pull over the materials with lower melting points in that they can be *hard* soldered easily and well.

TABLE IV.—GIVING PARTICULARS OF BRUNTON'S "BEACON" HIGH RESISTANCE MATERIAL.

S.W.G.	Size. Diameter. Inch.	Size. Diameter. mm.	Size. Sectional area. Sq. inch.	Yards per lb.	Resistance. In ohms per yd.	Resistance. In ohms per lb.	Price per lb. Black, hard or soft. s. d.	Price per lb. Plated, hard or soft. s. d.
8	·160	4·064	0·0201	5·6	0·06088	·3409	3 6	3 10
9	·144	3·658	0·0163	6·2	0·07752	·4806	3 6	3 10
10	·128	3·251	0·0129	7·9	0·1015	·8018	3 6	3 10
11	·116	2·946	0·0106	9·6	0·1219	1·1702	3 6	3 10
12	·104	2·642	0·0085	11·9	0·1499	1·7838	3 6	3 10
13	·092	2·337	0·0066	15·3	0·1892	2·6947	3 6	3 10
14	·080	2·032	0·0050	20·0	0·2436	4·872	3 6	3 10
15	·072	1·829	0·0041	25·0	0·3101	7·7525	3 7	4 0
16	·064	1·626	0·0032	31·2	0·406	12·6672	3 8	4 2
17	·056	1·422	0·0025	41·5	0·4640	19·2560	3 9	4 3
18	·048	1·219	0·0018	55·5	0·6502	36·0361	3 10	4 4
19	·040	1·016	0·0013	83·3	0·9746	78·2603	3 11	4 4
20	·036	0·914	0·0010	100·0	1·4127	141·2700	4 0	4 5
21	·032	0·813	0·0008	125·7	1·5892	199·7624	4 1	4 6
22	·028	0·711	0·000615	164·2	1·6146	265·3173	4 3	4 9
23	·024	0·610	0·000452	223·2	1·8836	420·4195	4 5	4 11
24	·022	0·559	0·000380	265·9	3·5377	940·6744	4 7	5 3
25	·020	0·508	0·000314	321·5	3·8915	1251·1172	4 9	5 6
26	·018	0·457	0·000254	396·8	4·3294	1717·9059	4 10	5 10
27	·0164	0·4166	0·000211	450·0	4·7517	2138·2650	5 3	6 3
28	·0148	0·3759	0·000172	600·0	5·2646	3158·7600	5 9	6 9
29	·0136	0·3454	0·000147	700·0	5·7291	4010·3700	6 3	7 3
30	·0124	0·3150	0·000120	800·0	6·2835	5026·8000	6 6	7 6

TABLE III.—GIVING PARTICULARS OF RESISTANCE, &C., OF "KRUPPIN" (METRIC DIMENSIONS).

Diameter in mm.	Cross-sectional area in sq. mm.	Weight gr. per m.	Number of metres per kg.	Resistance ohms per metre at 20° C.	Length metres per ohm.	Consumption in watts for a length of 1 metre on increasing the temperature from 20° C. to 60° C.	120° C.	200° C.	Resistance in ohms for a length of 1 metre at a final temperature of 80° C.	120° C.	220° C.	Current capacity in amperes for a length of 1 metre at a final temperature of 80° C.	120° C.	220° C.	Diameter in inches.	Nearest S.W.G.
0·5	0·196	1·588	629·7	4·343	0·230	1·0	2·0	3·3	4·525	4·647	4·950	0·469	0·60	0·816	0196	25
0·75	0·442	3·581	279·3	1·926	0·519	1·5	3·0	5·0	2·007	2·060	2·195	0·854	1·1	1·51	0296	22
1·00	0·785	6·360	157·2	1·084	0·922	2·0	4·0	6·6	1·129	1·16	1·236	1·33	1·73	2·31	0395	19
1·25	1·227	9·941	100·6	0·6938	1·441	2·5	5·0	8·2	·7065	·7425	·7910	1·88	2·41	3·21	0494	18
1·50	1·767	14·32	69·8	0·4818	2·076	3·0	6·0	10·0	·5020	·5155	·5490	2·45	3·12	4·11	0593	17
1·75	2·405	19·49	51·3	0·3540	2·825	3·5	7·0	11·6	·3689	·3788	·4035	3·08	3·91	5·36	0691	15
2·00	3·142	25·46	39·3	0·2709	3·691	4·0	8·0	13·2	·2822	·2897	3090	3·76	4·76	6·54	·0788	14
2·25	3·976	32·21	31·0	0·2141	4·671	4·5	9·0	15·4	2·230	·2291	·2440	4·5	5·68	7·94	·0887	13
2·50	4·909	39·77	25·1	0·1734	5·767	5·0	10·0	16·6	·1806	·1855	·1977	5·26	6·69	9·17	0985	12½
2·75	5·940	48·13	20·8	0·1433	6·976	5·5	11·0	18·0	·1493	·1533	·1634	6·05	7·22	10·5	·1083	12
3·00	7·069	57·27	17·5	0·1205	8·303	6·0	12·0	20·2	·1255	·1289	·1373	6·91	8·8	12·13	·118	11
3·50	9·621	77·95	12·8	0·08848	11·302	7·0	14·0	23·2	·0921	·0946	·1008	8·72	11·07	15·17	·138	10
4·00	12·57	101·84	9·8	0·06772	14·766	8·0	16·0	26·2	07055	·07246	·07720	11·55	13·5	18·44	·157	8
4·50	15·90	128·82	7·8	0·05354	18·677	9·0	18·0	29·8	·05580	·05730	·06104	12·7	16·13	22·1	·177	7
5·00	19·64	159·12	6·3	0·04335	23·071	10·0	20·0	33·0	·04516	·04640	·04942	14·9	18·9	25·8	·197	6

TABLE V.—COMPARATIVE PRICES OF METALS AND ALLOYS SUITABLE FOR RESISTANCES.

Gauge	Diameter.		German silver.				Platinoid.				Soft iron wire galvanised.				Hadfield's "Resista."				Manganin.				Kruppin.				"Eureka" (London Electric Co.).			
S.W.G.	Inches.	mm.	Per lb.		Per cwt.		Per lb.		Per cwt.		Per lb.		Per cwt.		Per lb.		Per cwt.		Per lb.		Per cwt.		Per lb.		Per cwt.		Per lb.		Per cwt.	
			s.	d.	£ s.	d.	s.	d.	£ s.	d.	s.	d.	£ s.	d.	s.	d.	£ s.	d.	s.	d.	£ s.	d.	s.	d.	£ s.	d.	s.	d.	£ s.	d.
8	·16	4·064	2	0	11 4	0	2	6	14 0	0	0	1½	0 16	4	2	6	14 0	0	...		...		2	6	14 0	0	2	3	12 12	0
10	128	3·251	2	0	11 4	0	2	6	14 0	0	0	1½	0 16	4	2	6	14 0	0	...		...		2	6	14 0	0	2	3	12 12	0
12	104	2·642	2	2	12 4	0	2	6	14 0	0	0	2	0 18	8	2	8	15 0	0	...		...		2	8	15 0	0	2	3	12 12	0
14	·08	2·032	2	2	12 4	0	2	6	14 0	0	0	2	0 18	8	2	8	15 0	0	3	2	17 15	0	2	8	15 0	0	2	3	12 12	0
16	·064	1·626	2	6	14 0	0	2	6	14 0	0	0	2½	1 3	4	2	9	15 8	0	3	2	17 15	0	2	8	15 0	0	2	3	12 12	0
18	048	1·219	2	6	14 0	0	2	8	15 0	0	0	2½	1 3	4	2	10	16 6	0	3	4	18 15	0	2	10	16 6	0	2	5	13 10	0
20	036	914	2	6	14 0	0	2	8	15 0	0	0	3	1 8	0	3	0	16 16	0	3	6	19 12	0	2	10	16 6	0	2	5	13 10	0
22	028	711	2	8	15 0	0	2	11	16 6	0	0	3½	1 12	8	3	2	17 15	0	3	8	20 12	0	3	0	16 16	0	2	8	15 0	0
24	022	·559	2	8	15 0	0	3	3	18 4	0	0	4½	2 2	0	3	5	19 4	0	4	0	22 9	0	3	6	19 14	0	2	11	16 6	0
26	018	·457	2	11	16 6	0	3	8	20 12	0	...		...		...		...		4	4	24 6	0	...		...		3	4	18 14	0
28	0148	·376	3	1	17 6	0	4	5	24 15	0	...		...		...		...		5	2	28 18	0	...		...		4	0	22 9	0

NOTE.—(*a*) Wire made of *best charcoal iron* is about two and half times as expensive as the iron wire given in above table. (*b*) "Constantan," made by Basse and Selve, of Altena, Westphalia, can be bought from Mr. August Reichwald, Dashwood House, E.C., at the following prices:—

Diameter mm.	·15	·24	·35	·50	·70	1·00	1·40	2·40	3·60
Ohms per metre in length..	28	11	4·8	2·5	1·3	·62	·28	·11	·048
Price per lb.	2s. 10d.	2s. 6d.	2s. 3d.	2s. 2d.	2s. 0d.	1s. 11d.	1s. 10½.	1s. 10d.	1s. 10d.

Table V. gives the comparative cost of the various alloys, and it should be noted how very much cheaper is galvanised iron wire than any of the other metals. This, coupled with its ability to withstand high temperatures without sagging, makes it very largely in demand for resistances.

Extra large resistance frames, such as are used for testing dynamos, &c., are cheaply made from ordinary galvanised iron wire netting, folded up and down in a large wooden frame, like an end of cloth in a drying machine. Or the strip of netting (say, 12 inches wide 1 inch mesh) may be wound round and round from the centre outwards, the adjacent layers being kept, say, 3 inches apart by $\frac{3}{4}$ inch iron rods at the four corners. Resinous wood, like pitch-pine, should not be used, in fact the best job would be made by using wood which has been specially treated to make it inflammable.

The resistance of galvanised iron wire netting of No. 20 B.W.G. 1 inch mesh and 12 inches wide would appear to be about ·005 ohm per yard in length, and the safe current 90 to 100 amperes.

(*To be continued.*)

THE DEVELOPMENT OF THE CENTRAL STATION.

An address upon the above subject was recently delivered by Mr. Samuel Insull, president of the Chicago Edison Company, before the students of the Purdue University. He begins by practically disclaiming knowledge of technical matters—although the Directory describes him as an electrical engineer—and he refers to "the disadvantages that a commercial man invariably feels when discussing technical matters before those having had technical training." In the course of his introductory remarks he says, "In referring to the development of the central station it would seem hardly necessary to go at length into the history of the business," &c. We should have thought that a description of the development of a thing and its history were practically one and the same thing. Mr. Insull, however, thinks otherwise, and so devotes fully half of his address to the development of Edison and a description of his various patents, proving (to his own satisfaction) that Edison invented practically everything that goes to make electric lighting possible. He then proceeds to give a biographical sketch of the inventor from the time when he was a telegraph operator in the Western Union service up to the formation of the Edison Electric Illuminating Company of New York and the erection of the Pearl Street station in 1882. The speaker then shows his audience "a photograph of the original direct coupled steam generator known as the 'Jumbo' machine used in the Pearl Street station," and after stating the points of similarity and difference between this and a modern direct coupled set, he continues: "That we should come back to *exactly* (italics are ours) what Mr. Edison used in the earliest central station work, is no mean tribute to him as an engineering authority." In this connection we quote a remark made by Mr. Insull at the commencement of his address: "I recalled that so recently as the early eighties it was necessarily the rule for 'guessing to be a substitute for mathematics' (to use the words of the great pioneer in central station work)."

It would be interesting and instructive to know to what extent, respectively, accident and design entered into this adoption of direct coupled plant at that time. We venture to say that, in England at least, the question of space saving is one of the chief considerations in the abandonment of rope-driven plant, and not so much a question of engineering. The speaker does not consider that any particular advantage could have been served by going into an investigation of early alternating work, and states that "whilst it undoubtedly helped central station development at the time, it proved very uneconomical in operation, and expensive in investment, when the cost of converters is added to the cost of distribution." He omits, however, to credit the system with the saving on mains and improved regulation, and as he gives no figures, it is not possible to further criticise his remark. His objection, however, to the house-to-house transformer system is shared by us, and has, of course, long since been practically abandoned in England. He speaks favourably of two and three-phase currents and the rotary transformer as a means of economising the cost of production by concentration of power, and describes a scheme adopted in many of the large cities of alternating transmission at high tension combined with low tension distribution, and states that even now it is quite possible "to transmit economically from the centre of any of our large cities to the distant suburbs by means of high potential alternating currents distributing the current from the sub-centre distribution by means either of the alternating current itself and large transformers for a block or district, or else, *if the territory is thickly settled* (italics ours) by means of a system of low tension mains and feeders, the direct current for this purpose being obtained through the agency of rotary transformers."

Why it should be necessary to transform into direct current in thickly settled districts when low tension alternating can be obtained at once without rotary apparatus is not explained.

Station engineers in America appear to be quite ignorant of the fact that no difficulty has been observed in England in supplying from centre to suburbs of large cities or districts economically with high tension single-phase alternating currents without the use of rotary transformers.

Mr. Insull describes several methods of producing alternating currents for transmission purposes, *e.g.*, generators wound for high potential, generators wound for 80 volts, and step-up transformers to obtain the required pressure, dynamos having collector rings on one side and commutators on the other, so that you can obtain either, and so on. By the way, 80 volts seems to be quite a favourite pressure in America, and they seem to be as much in want of standardising as we are in England.

The composite machine, having both collectors and commutator, he states, has been found very useful when the peak in two districts of a city comes at different times, as low tension continuous can be supplied to the points near the station, and alternating current to distant parts. We presume, however, that this only applies to stations whose system of supply is ostensibly low tension continuous.

Mr. Insull refers to "the latest development of central station transmission," which consists of alternating high tension "carried to distant points and then used to operate series arc light machines run by synchronous motors," &c. He remarks that "it would be interesting to go at length into the detail cost," and we think it would be equally interesting to know why the additional complication of motor generators should be necessary when excellent arc lighting can be obtained from alternating current direct.

The speaker now passes to the question of costs, and confines his remarks to the business of the Chicago Edison Company, and points out that "by far the greatest item of *cost of your product* (italics are ours) is interest on the investment," and refers to this later as being the most important factor in calculating *profit and loss*.

We presume the Chicago Edison Company is financed in the usual manner, viz., by public subscription and issue of shares, how the "interest," or as we in England would call it, "dividend," can possibly be looked upon as a factor in the cost of production or in the calculation of profit and loss we do not understand. Surely a dividend is (or should be) all profit. If the company is heavily mortgaged, the payment of debenture interest would have to be considered by the ordinary shareholders as a part of the cost of production, and the matter is then clear; or possibly he refers to depreciation, but what he actually does mean is not obvious to us although it may have been to his audience. He naturally objects to excessive capital investment in the following words: "It is a common mistake for the so-called expert to demonstrate to you that he has designed for you a plant of the highest possible efficiency and at the same time for him to lose sight of the fact that he has saddled you with the highest possible amount of interest on account of excessive investment." Here we entirely agree with him, and we think the majority of English station engineers have long since ceased to be beguiled by the man whose dynamo or engine is stated to be 1 or 2 per cent. more efficient than the others, while the first cost is raised to fancy figures "on account of the great saving effected."

While Mr. Insull objects to excessive investment, he is evidently alive to the folly of putting down plant simply because it is low priced, and without regard to efficiency and stability, for in referring to the Harrison Street station he says:—"Every effort has been made to provide for the economical production of steam, low cost of operating, good facilities for repairs and consequent low cost, and for permanency of service."

In regard to the use of storage to meet the peak of the load, he is of opinion that it would be economical where the peak does not exceed from 2 to 2½ hours. Doubtless many English engineers will agree with him, but others would suggest that for about the same capital outlay a spare engine and dynamo could be procured, which would *generate* without the initial loss of 30 per cent., and a falling capacity year by year, to say nothing of the heavier depreciation and attendance costs.

That he has the courage of his convictions is proved by the fact that a very large battery is now being installed by his company, and particulars of which were reported in a recent issue.

He goes very fully into the question of charges, and details the various sliding scale and other methods adopted with a view to encouraging the long hour consumer, the experience in America apparently coinciding very closely with our own, and showing the load factor of the average city office as 3·7 per cent., and that of the all-night restaurant as 48 per cent., with other classes of consumer in proportion. He considers the maximum demand (Wright) system particularly equitable, and uses the following apt illustration in its support:—

"No one would think of going to a bank to borrow money, and expect to pay precisely the same total interest, whether he required the money for one month or for 12; and for the same reason it seems an absurdity to sell electricity to the customer who uses it but a comparatively few hours a year at the same price at which you would sell it to the customer using it 10 hours a day, and 300 days a year, when it is remembered that interest is the largest factor in cost, and the total amount of interest is the same," &c.

Free wiring is apparently not in favour in America, as he says: "The expense of wiring (which must of necessity be borne by the householder) is large, and is often a barrier to the adoption of electric illumination," &c.

It is disappointing to find that although he says: "I have prepared graphical representation of the cost of current," &c., they have not been published, and there is not the slightest hint throughout his published address by which we may form any opinion as to the probable cost per unit. He, however, says: "To-day there are many stations showing a substantial return on their investment, whose average income does not exceed 7 cents per kilowatt-hour." The maximum load of the Chicago Edison Company was last year 12,000 H.P., or more than double that of any English undertaking. The price is, therefore, by no means phenomenally low when we remember that in England one London company's average charge last year was less than 4½d. (or say 9 cents) per unit, and whose maximum load was about one-fifth of that of the Chicago company.

At the conclusion of his address, and speaking of possibilities in the future development of central stations, he says: "It is within the realms of possibility that the present form of generating station may be entirely dispensed with. It has already been demonstrated experimentally that electrical energy may be produced direct from the coal itself without the intervention of the boiler, engine, and dynamo machine. Whether this can be done commercially remains to be proved. Whatever changes may take place in generating methods, I should, were I not engaged in a business which affords so many remarkable surprises, be inclined to question the possibility of any further material change in the distributing system." He, however, thinks that improvements in lamps and such translating devices may take place, and "the possible effect on cost, and consequently on selling price, would be enormous." Whether he would welcome such an improvement or not he does not say, but judging from his views of the importance of interest on capital invested as a factor in cost of production we fancy he would not desire to see a lamp introduced with an efficiency, say, twice as high as those in use, and universally adopted, unless it was done very gradually indeed.

LEGAL.

CASTNER-KELLNER ALKALI COMPANY, LIMITED, *v.* COMMERCIAL DEVELOPMENT CORPORATION.

THE case of the Castner-Kellner Alkali Company, Limited *v.* the Commercial Development Corporation, Limited, came before Mr. Justice Bigham in the Chancery Division on the 14th inst. It was an action for an injunction to restrain the defendant company from manufacturing, selling, or exposing for sale any caustic soda or other alkali, in infringement of the letters patent granted to Carl Kellner in 1894 (No. 20,259) for an alleged invention of improvements in electrolytic apparatus for decomposing metallic salts. There was also an alternative claim for damages, and for an account of the proceeds of all caustic soda or other alkali manufactured and sold by the defendants in the infringement.

Defendants denied the infringement, and pleaded that the alleged invention was not new or useful, and that it was not the proper subject-matter for a patent. They also said that the specifications of the alleged invention were imperfect, insufficient, ambiguous and misleading, and that the letters patent were invalid. Defendants said that at the date of the plaintiffs' letters patent there had been prior publication:—(*a*) By letters patent granted to George Jones Atkins and Edward Applegarth, dated December 19th, 1890 (No. 20,768); (*b*) By specification (provisional and complete) of letters patent, granted to Eugene Hermite and Andre Dubose, dated December 15th, 1891 (No. 21,959); (*c*) By the provisional specification of Andre Leopold Wolf for apparatus for producing chlorine gas and metallic sodium from chloride of sodium, dated September 12th, 1882 (No. 4,349); (*d*) By specification of United States patent for a process and apparatus for obtaining chlorine and sodium, granted to Andre Leopold Wolf, dated October 5th, 1882 (No. 271,906), and duly placed for public use in the Patent Offices Library in London in or about August, 1884; (*e*) by specification (provisional and complete) of letters patent granted to Camille Petri, dated June 2nd, 1886 (No. 7,426); (*f*) by the complete specification of letters patent granted to Hamilton Young Castner, dated September 7th, 1892 (No. 16,046); (*g*) by complete specification of letters patent granted to Peter Jansen, dated August 3rd, 1893 (No. 14,910); (*h*) by specifications (provisional and complete) of letters patent granted to Alf Sending Larsen (No. 18,499), 1894.

Mr. Fletcher Moulton, Q.C., Mr. Bousfield, Q.C., Mr. J. C. Graham, Mr. A. J. Walter, and Lord Robert Cecil appeared for plaintiffs; and Mr. J. Terrell, Q.C., Mr. Astbury, Q.C., Mr. J. A. Gray, and Mr. MacConkey for defendants.

Mr. FLETCHER MOULTON said the invention related to the manufacture of caustic soda, which was an oxide of the metal sodium. Of late, instead of the old chemical methods of obtaining caustic soda, it had been found that the electrolytic method was a far better way of getting it. Counsel explained the basis of plaintiffs' invention, and pointed out that, though something like that method of obtaining caustic soda had been known, it was never practicable, because it involved the use of separate vessels—a circumstance which proved a hindrance to the production of a commodity which was manufactured by the ton. In 1892 an inventor named Castner made a stride towards obtaining a continuing process by electrolysis, but Mr. Kellner ran him very close. Two years later Mr. Kellner invented an appliance which was the subject of the patent on which the claim was being made in this action. Mr. Castner patented his invention, but no claim was being made upon it. Mercury was used in obtaining caustic soda, and Mr. Kellner's invention enabled the mercury to be charged and discharged in one operation by means of an inverted bell charged with a solution of salts, and moved at pleasure in a vessel of water, at the bottom of which lay the mercury. Counsel described the invention as consisting of two containers, one (the inverted bell) containing the solution of salts through which a current of electricity was sent, and the other containing mercury covered with water. The date of the plaintiffs' patent was October 23rd, 1894. The defendants' patent was dated 1897, and he pointed out that it had, like the plaintiffs' patent, a container with mercury in it, and a bell containing a solution of salts through which the electric current was sent. The difference was, that the mercury lay in projections under the container or gas chamber, but water passed over these projections, and the chemical process was exactly that of the plaintiffs' patent.

At this stage the hearing was adjourned till Friday.

FRIDAY'S PROCEEDINGS.

Mr. FLETCHER MOULTON continuing, addressed himself to the point of disconformity, and pointed out that the provisional specification foreshadowed with reasonable but not absolute precision the nature of the invention sought to be patented, and the complete specification might contain variations from the provisional but must not differ from it in essential particulars. What he meant was that there must not be anything in the complete specification so entirely new and different as to be in disconformity with the claims of the provisional specification. The object of a provisional specification was to enable an inventor who had made a discovery or invented a piece of novel mechanism to get a provisonal plant for a few months, during which he was at liberty to improve and develop his invention. The inventor was allowed to make any addition he chose so long as it was in accord with the fundamental invention. Mr. Moulton then went on to state the principle which governed the patent law by a reference to Mr. Edison's invention of the telephone transmitter. In that case the provisional specification was taken out and the inventor proceeded to develop his machine, with the result that he produced the phonograph, one of the greatest inventions of our time, a machine to produce articulate sounds by indentations on a metal surface. Unfortunately, Mr. Edison included the phonograph

in his complete specification of the telephone, and Mr. Justice Fry (as he was then) had no alternative but to disallow the patent on the ground that the complete specification, because it included the phonograph, was a disconformity with the provisional specification, which claimed only for the telephone. Applying this illustration to the present action Mr. Moulton admitted that there were additions to the plaintiffs' invention as described in the complete specification, but they were all in uniformity with what was claimed in the original specification, and possessed no feature of disconformity. Referring to the defendants' apparatus, the learned counsel submitted that though it showed differences of construction, yet it carried out precisely the process patented by the plaintiffs, and therefore came within the Castner and Kellner specifications, thus depriving the plaintiffs of the profit which the law said they should enjoy for a novel invention. Otherwise, if an inventor was not protected, he would have no inducement to obtain new discoveries which could be copied by others. The whole effect of the patent law was to insure that an inventor should be protected against infringements by inventions which did not differ from his principle, though they might adopt some method of arriving at the same result. In the plaintiffs' invention, the novelty was that the mercury used in obtaining the caustic soda was kept stationary in its pan while the chambers holding the salt solutions moved over a steel sheet charging and discharging the mercury, and just keeping up a continuous process. In the old process it had been thought necessary to paddle the fluid mercury round and round in its container, but it was Mr. Kellner who discovered that it was wholly unnecessary to move the mercury, and this was the novelty of his invention. The way the infringement stood was this: The plaintiff first heard of it by the appearance of a prospectus of a company which proposed to sell this invention for a very large sum of money to the public. The plaintiffs took steps to assert their rights, and the defendants thereupon brought an action for threats, and made an admission that they were going to use Rhodin's patent No. 21,509 of 1896.

MR. JAS. SWINBURNE, examined by Mr. BOUSFIELD, said he had read the specifications referred to. The witness gave evidence broadly to the effect that the chambers or inverted bells containing the solutions of salt passed over the surface of mercury. Each portion of the mercury covered by the bell was charged with sodium. After the bell passed on to another portion of the surface of mercury, the part it had left was exposed to water and was discharged of the sodium. The charging was effected by sending an electric current through the solution in the bells. In this way the charging and discharging was kept up continuously, and the whole process was effected with a small amount of mercury compared with the old process of moving fluid mercury. The Witness explained earlier methods of obtaining caustic soda with the object of showing the novelty of plaintiffs' patent, and in reference to that of defendants' patent he pointed out that it acted on the principle of first covering the mercury and then having it exposed to the water, there charging it and discharging it in the same way as the Castner-Kellner patent.

Cross-examined by Mr. TERRELL: The idea of electrolysing salt so as to produce sodium and chlorine was very old.

In answer to his LORDSHIP, Mr. TERRELL stated that he was going to show exactly what Kellner had advanced upon the knowledge before him, and then to show that the small amount of advance he had made was just the part the defendants had not taken.

The WITNESS, further cross-examined, said that in Atkins and Applegarth's patent of 1890 there was a device by means of which salt and water was electrolysed, the sodium being carried into the mercury in one vessel and then the mercury was turned into another vessel and decomposed by means of water. In Castner's specification he had got two poles, two separate partitions, one of them to contain the salt solution to be electrolysed. They were separated from each other by a partition which went down until it touched the mercury and sealed and divided the salt solution from the water. The cells were fixed, the two containing vessels being both covered in at the top. At the bottom there were moving arms revolving slowly, and the mercury was brought by these revolving arms from the cell where it is charged with sodium, to the cell where it was discharged of sodium back again, and the process was continuous. The moving arms moved the mercury by direct propulsion, and that might be moved either like that or by friction. The mercury was partly driven by the paddles and partly by friction.

His LORDSHIP: Substantially instead of moving the mercury by paddles the bottom of the pot revolves and that is the same movement of the mercury?—The witness replied that it was practically.

The WITNESS said that Kellner (in fig. 7) had got a bottom (*a*) on which the mercury rested and so far he was like Castner. He had the bottom (*a*) made into a separate dish, and so far he was different from Castner. He revolved the dish with the mercury in it.

The dish (*a*) revolved and revolving carried the mercury with it. So in relation to the fixed bells the mercury in Kellner was shifted from place to place just the same as it was in Castner by different means. In the one case the mercury was moved by being disturbed, whereas in the other case it was carried, so to speak, bodily round. In relation to the cells the movement was the same.

His LORDSHIP: If I carry a glass of water I do not call that water flowing although I am moving it from one place to another.

Mr. TERRELL: Yes, that is true. You have got the statement of my learned friend that his invention was stopping the actual flow of the mercury. I am going to show, I think, that the specification does not say that, and that is an invention of my learned friend who tries to create a distinction between Castner and his patent.

Cross-examination continued: In Kellner as in Castner the cells were fixed and the mercury was transposed from cell to cell by being moved from one to the other by mechanical means. This patent of Kellner was not now in actual use in England he thought—at least, so far as he knew.

His LORDSHIP (to Mr. Bousfield): Are you bringing an action for the infringement of a patent which you have never used?

Mr. BOUSFIELD: That is so; but your Lordship sees we own a group of patents.

His LORDSHIP: A sort of dog in the manger?

Mr. BOUSFIELD: We own a group of patents, and we have certain improvements not before your Lordship, and we use the very best.

His LORDSHIP: At present you are bringing an action for infringement of a patent you do not want.

Mr. BOUSFIELD: Yes, but Rhodin wants to compete with us and to sell it for a large sum of money to the public.

His LORDSHIP: You do not want him to have your bone, although you do not want it yourself.

Mr. BOUSFIELD: We wish to retain our monopoly.

Mr. TERRELL (to witness): You heard Mr. Moulton in his opening suggest economy of mercury as a point?

His LORDSHIP: He did not say it was shown in the specification, but that it was alleged in the specification. There is nothing whatever to show that mercury was saved.

Mr. TERRELL: I was going to show the failure of his argument (to witness). In Castner's (fig. 1 of 1892), both operations take place simultaneously and uninterruptedly?

The WITNESS replied that he was not sure in Castner's whether he had not to stop one of his cells at the time.

Further cross-examined, the WITNESS said that in his opinion there was no advantage of a commercial point of view in Kellner's over Castner's 1892 patent (No. 16,046) so far as the saving of mercury was concerned. He thought that in that particular, fig. 3 of Castner, probably less mercury would be required to work it than in Kellner's patent.

His LORDSHIP: I thought that the great object in Kellner's was to save the mercury, but if you tell me that Castner's saved as much ——?—I think that Castner's apparatus (fig. 3) effects as great an economy of mercury or greater than Kellner.

In answer to his LORDSHIP, Mr. TERRELL said that he should submit at the proper time that, if the defendants had infringed, there was no subject-matter for the plaintiffs' letters patent, because there was no substantial invention over and above what Castner had done before.

His LORDSHIP: Well, just let us see about that. It is suggested by Mr. Moulton and by this witness that there is an advantage in carrying the mercury quiescent as distinguished from flowing, and that that is sufficient novelty and improvement to form the subject-matter of the patent.

Mr. TERRELL: That advantage has been over and over again held not to satisfy the requirements of the patent law. It must be an advantage which involves substantial invention.

His LORDSHIP: At all events, you say that if you have infringed by what you have done then it does not matter, as this man's patent is not a good patent, but simply a repetition of what has been invented long before, and where it differs from anything before, it does not form the subject-matter of a patent.

Mr. TERRELL said that that would be his submission.

At this stage the hearing was adjourned till Saturday.

SATURDAY'S PROCEEDINGS.

The hearing of the case was resumed on Saturday.

Mr. TERRELL, in reply to his LORDSHIP, said that he was going to admit that if there was any distinction between the rotatary movement and the to and fro movement described in fig. 1 of Kellner, then there was no practical distinction between the defendants' apparatus and that of the plaintiffs'.

Mr. Justice BIGHAM: You say that I ought to distinguish one from the other?

Mr. TERRELL: Yes.

Mr. Justice BIGHAM: Will you explain why?

Mr. TERRELL: Your Lordship has thoroughly appreciated the fact of the problem which is being solved in all these apparatus, viz., as to the absorption of the sodium in the mercury and the subsequent discharge of the sodium. I contend that in a to and fro movement such as is described in Kellner, figs. 1 and 2, you first of all bring the whole of your mercury under the influence of the absorbing process, and then as a separate operation, distinct from that, you bring the whole of your amalgam under the influence of a discharging process.

Mr. Justice BIGHAM: Of the water?

Mr. TERRELL: Yes, and so you have got an intermittent process, whereas, in the other case, you have got a continuous process all the time.

Mr. Justice BIGHAM: What is the difference?

Mr. TERRELL: There is an immense difference in practical utility.

Mr. Justice BIGHAM: Is that what you claim in your patent?

Mr. TERRELL: Oh, no. The claim in our patent is the particular apparatus by which we do it.

Mr. SWINBURNE was recalled, and further cross-examined by Mr. TERRELL, but he made no variation from his original evidence.

Lord KELVIN, examined by Mr. BOUSFIELD, said he had compared the apparatus of Rhoden's specification with the apparatus described in Kellner's specification. He expressed a preference for the Kellner as compared with the Castner process.

Mr. Justice BIGHAM asked what process the plaintiffs at present used?

Mr. BOUSFIELD replied that the Castner process was used with a modification which consisted of rocking the mercury.

Mr. Justice BIGHAM: Can you tell me why the Kellner process is not used?

Lord KELVIN: The reason is that the Castner rocking process was successfully carried out at Birmingham, and did good work. It was

also carried out with equal success at Runcorn. Then came Mr. Kellner's invention, which is still better, and the next works that are erected will be supplied with Kellner's patent. Were I erecting works, I should not hesitate for a moment to adopt the Kellner process in preference to the Castner.

Mr. Justice Bigham: What is the advantage of Kellner over others?

Lord Kelvin: Because there is very little stirring of the mercury, which never moves in the lower part relatively to the bottom of the pan in which it is contained. The less stirring of the mercury the better for the process, and I should say that if the Rhodin process is to go on, the defendants would do better to have a pan with a smooth bottom. Continuing, the Witness said that save for the movements of the lips of the bell, the mercury in Kellner's patent was practically stationary, the motion being hardly perceptible, and in the defendants' apparatus the mercury was also stationary, and in this respect was hardly distinguishable from the plaintiffs' invention. He regarded the defendants' process as inferior to that of the plaintiffs.

Asked if there was any practical difference between the moving of mercury under the chamber, and moving the chamber over the mercury, Witness replied that there was none whatever. There was no practical difference between a to and fro and a circular movement, or between an intermittent and a continuous movement.

This closed the evidence for the plaintiffs.

Mr. Justice Bigham, addressing Mr. Terrell, said the effect in his mind was that the real point between the parties was whether there was any difference between the circular motion and the backwards and forwards motion of the bells. His impression on the evidence so far was that there was no substantial difference, and he was satisfied that there was no disconformity between the complete and the provisional specifications, the complete showing nothing more than another way of using the original invention. That was the point to which the learned counsel should address himself, that really being the sole point in the case.

The Court adjourned.

Monday's Proceedings.

On Monday, Mr. Terrell, for the defendants, addressed his Lordship. He observed that the essence of Kellner's patent, as put forward by Mr. Moulton, was the use of stationary mercury, and he had added that the result of the stationary mercury was the economy of the mercury by reason of the less space covered by the mercury as compared by the Castner process by the economisation of the space of the blades. He contended that the saving effected by the plaintiffs' process was infinitesimal compared with the other processes.

Mr. Bousfield observed that any comparison with other processes could not be instituted. The question was, Did the process constitute something different to what had existed before, and if it did, then it was an invention of something useful, which was therefore the proper subject of a patent and could be protected.

Mr. Terrell said what his friends had to do was to show that, taking the public knowledge at the time Mr. Kellner took out his patent, there was a substantial amount of invention in what he had done. Mr. Kellner had to show not only that there was substantial invention in his process, but he had also to show the substantial utility of that invention. Mr. Moulton had said that the invention here was in introducing a stationary cathode where a movable cathode was used before. He might as well say he put in a screw where a nail was used before, but if the substitution produced no other result, then it could not be put forward as any improvement. His contention was that Mr. Kellner left the process just the same as it was before, there being only a slight change in the operation, and that, therefore, there was no subject-matter for a patent, because there was no substantial invention. The whole point really was: was there any substantial difference between the Castner and the Kellner process? He submitted that a detailed examination of the two processes showed that there was not, and that there certainly was no saving of mercury in the Kellner as compared with the Castner process. If one machine is different to another, and there was some invention shown in effecting this difference, then it was the proper subject-matter for a patent. It must involve something more even than invention. It must involve substantial invention so as to make the manufacture to which it applied a new manufacture within the meaning of the language of the statute of monopolies. This, however, was not a different invention, but was practically the same. Mr. Kellner had just left the process where it was save that he made a slight change in the operation, therefore his invention was not subject-matter for a patent, as there was no substantial improvement. In fact, the whole point was whether there was any difference between the Castner, at present in use by the plaintiffs, and the Kellner process, which had not yet been used by them, and he contended that no difference had been shown, and that, therefore, it could not be said that there had been an infringement by the defendants of the Kellner patent. On the question between the Kellner complete and provisional specifications, he would point out that the provisional only referred to a backwards and forwards movement of the bells, and that the complete specification included the rotatory movement of the solution chamber. His Lordship on Saturday had intimated that he was inclined to treat that as no disconformity, but the witnesses for the defendants and the experts on their behalf would say that the rectilinear and the rotatory movements were not the same, and that there was disconformity.

Mr. Justice Bigham intimated that he was prepared to hear such evidence, but at the same time, if disconformity was not shown, then the defendants were driven to infringement. It appeared to him that the one point involved the other. What was moving in his mind was this: In the Kellner patent the mercury was stationary relatively to the vessel in which it was contained, whereas in all previous methods the mercury was fluid and movable.

Mr. Terrell said it was Mr. Moulton who had put forward this claim as to the stationary cathode and not Mr. Kellner.

Mr. Justice Bigham: It was in the Kellner specification as plain as a pike-staff that the invention is for the purpose of obtaining caustic soda by means of a stationary cathode of mercury.

Mr. Terrell: Yes, by means of a to and fro movement.

Mr. Justice Bigham: No; by a stationary cathode. There it is in the specification.

Mr. Terrell: It was Mr. Moulton who insisted on the stationary cathode, not the inventor.

Mr. Justice Bigham: That may be true, but does not matter.

Mr. Terrell: Oh yes; it depends upon what the inventor claims in his specification, and his claim is a stationary cathode for continuity of process. He did not (counsel continued), suppose that there ever was a case produced before a Court with less evidence than the present case. Not one witness had been called from the works to point out to his Lordship the utility of Kellner's patent, and to indicate the difficulties which Kellner had had to overcome. His Lordship had only been assisted by gentlemen of the greatest experience and learning — Mr. Swinburne and Lord Kelvin — but neither could give him any straightforward account of this invention at all. He (the judge) was asked to infer that because there was a difference between a stationary cathode and a moveable cathode, that, therefore, that difference was to be the subject-matter for a patent, with no evidence whatever that it involved any change to bring it about

Evidence was then called on behalf of the defendants:—

Mr. Dugald Clerk, cross-examined by Mr. Astbury, Q.C., stated that he had carefully examined the invention as described in Kellner's specifications, and the various specifications prior in date, and the apparatus of the defendants.

What do you understand is the meaning of the invention described in the provisional specification of Kellner, bearing in mind what is known at the time?—As I understand the provisional specification this inventor intends to arrange mercury in definite patches, so that he can charge his mercury surface definitely, and then expose the whole of that surface after charging to the action of water. The invention clearly showed the way of carrying that out.

In reply to his Lordship, the Witness stated that the difference between the provisional and complete Kellner specification was that the former dealt with definite patches of mercury, whereas the latter dealt with indefinite patches.

Mr. Astbury: In so far as the production of soda is concerned, is it necessary in every machine to have a flow of the mercury from the decomposing chamber to the containing chamber, and round and round?—It is necessary to have a change of the mercury from one chamber to another; whether it is flowing does not matter.

Is it material, in your opinion, whether that change is produced by moving round your bells or moving round your mercury, as far as the ultimate result is concerned?—It is not. He added that in the Kellner provisional specification he did not find any suggestion whatever of secondary cellution. Fig. 9 was, in his opinion, a departure from Kellner's provisional specification. The feature of claims 1 and 2 of Kellner was the preservation of the alternating patches of mercury. He found nothing similar to that in the defendants' machine. The difference between the defendants' process and the complete Kellner was that the former had a water space outside the bell where the continuing process was effected.

Mr. Astbury: Taking the whole of the claims in Kellner's patent, is there in the defendants' apparatus anything, in your opinion, within the meaning of the language of any one of the claims?

Mr. Bousfield: That is for his Lordship to say.

Mr. Justice Bigham: Yes, I think so.

Mr. Astbury: Very well. I will just ask this question: Is it possible in any sense to say that in the defendants' apparatus there is a stationary mercury cathode?—No.

Mr. Justice Bigham: By that you mean that there is an agitated or stirred up mercury cathode?—Yes, my Lord. Continuing, he said there was such an agitation as to alter the position of the mercury relatively to the vessel in which it was contained. The blade of the projection, which formed the seat of the solution chamber, must act as an effective operation in stirring up the mercury. He thought it a fallacy to say that the blade would slide over the mercury.

Mr. Justice Bigham pointed out that Mr. Rhodin, in his specification, had apparently fallen into the fallacy of speaking of the blades as sliding over the mercury.

Witness thought that Mr. Rhodin was wrong there.

Mr. George Grindle, electrical engineer, examined by Mr. Terrell, said that he was manager of the Electrical Storage Syndicate. He had tried a series of experiments with Rhodin's apparatus, which he had found to be highly efficient. Its total efficiency had easily reached as high a figure as 93·2 per cent. That was a very high degree of efficiency in such an apparatus. Rhodin's patent owed its extraordinary efficiency to its perfect circulation of mercury, which enabled him to use a larger number of amperes of electricity than if he had not got it. He had worked the apparatus up to as high as 1,100 amperes of current. He had never, in fact, worked Kellner's apparatus, and never heard of anyone who had. Kellner's apparatus, in his opinion, was by no means a practical apparatus.

In cross-examination by Mr. Bousfield, he said the object of Rhodin's patent was to prevent the mercury from revolving, because if it did it would simply carry underneath the pot the mercury and amalgam which would revolve round and round with it. It was essential that while the bell was rotating the mercury under the pot should not revolve. In his opinion Rhodin's apparatus was superior to that described by Kellner's specification. The point of superiority

was more water to combine with the mercury and the proper circulation of the mercury—throwing outwards the mercury. Those were the two main points. The amount of circulation depended to some extent on the speed at which they rotated. His syndicate was not interested in the defendant company, nor had it taken any shares in it. Some of the directors of his syndicate were also on the directorate of the defendant company.

Prof. Charles Vernon Boys, F.R.S., said he had investigated this matter. The action that took place in Kellner (figs. 7 and 8) was substantially the same as that which took place in the Castner process. There were substantial differences between the Rhodin and Castner processes. He had heard the evidence of Mr. Dugald Clerk, and, generally speaking, he agreed with it.

Mr. John Gustav Rhodin, the patentee of the Rhoden patent was examined, and stated that his machine owed its efficiency to the rapid circulation of the sodium through the main bulk of the mercury, making the mercury act as a kind of sieve for the sodium. He had seen Kellner's specification, and Mr. Kellner's invention, in his opinion, was absolutely impracticable in several respects. He had sold his patent out and out for cash, and had no interest whatever in the defendant company beyond shares to the extent of £1,000, which he purchased in the open market.

Cross-examined by Mr. Bousfield: How much did you sell your patent for?—I sold the English and foreign rights for £5,000.

That was a beautiful sum, was it not?—Well, it depends. I don't suppose you would call it so.

To whom did you sell your patent?—To Mr. A. R. Harvey, of Liverpool.

Is he the promoter of this (the defendant) company?—That I do not know.

Was he the gentleman who was then going to sell it to the company for £90,000?—That I do not know. I know nothing of what his business is, or any more about him than you.

This closed the evidence for the defence, and

Mr. Terrell addressed his Lordship on behalf of his clients, contending that the plaintiff had made out no case which would entitle him to a patent for his invention, and that, therefore, the defendants could not be held to have been guilty of any infringement.

The Court adjourned.

The hearing of the case was resumed on Tuesday, when Mr. Bousfield, on behalf of the plaintiffs, replied on the whole case, contending that his clients had fully established their claim, and were entitled to succeed in this action.

His Lordship reserved judgment.

Weblyn *v.* Shoolbred.

In the Official Referee's Court of the Chancery Division, on Wednesday last week, before Mr. Verey, the Official Referee, the action of Weblyn *v.* Shoolbred came on for hearing. Mr. Fletcher Moulton, Q.C., Mr. R. Wallace, Q.C., and Mr. Gaskell appeared for the plaintiff, Mr. Lawson Walton, Q.C., and Mr. Pollock for the defendants.

Mr. Fletcher Moulton said that he appeared for Mr. Walter C. Weblyn, who sued on his own behalf and that of others who were interested with him. The defendants were Messrs. James Shoolbred and Co., the well-known upholsterers. The action was for damages due to the defendants having negligently carried out certain works for the plaintiff in the way of putting up the electric lighting at 80, Strand, last July, where the plaintiff was exhibiting a picture called "A Royal Harem." The picture thereby was seriously damaged, and the plaintiff lost the profit he would otherwise have made in the way of exhibition. The defence was admission of the employment—and admission to the employment brought with it the duty of executing the work in a skilful and workmanlike manner—and denial of the negligence. They also put in a counterclaim for £269 19s. 10d., as the cost of putting up the electric light and the various other fittings. This plaintiff admitted, and was willing it should be deducted from the damages. Messrs. Shoolbred were asked to carry out the wiring at prices which corresponded with exceedingly good work. The learned Counsel proceeded to describe the arrangement of the room. The picture was placed near one end of the apartment. In front of it were two screens, covered with curtains. Behind the drapery was a tin reflector, pointing towards the picture. That was to throw light on the painting. The lights were pendant electric lights, hanging by flexibles, in which both wires were on the same cord, insulated by cotton or silk. In the centre there was a larger light, of 100 candle-power, with a conical reflector over it, which also threw light on the picture centrally. Current was to be derived from the Hotel Cecil up to 30 amperes. In addition to the light inside, there was to be light provided for the poster outside. On the afternoon of July 10th the light suddenly went out. There was a bright flash. Almost immediately the draperies caught fire. After considerable trouble the picture was got out of the burning room, but sustained considerable damage. When the learned referee came to hear the facts, which would have to be admitted, he would come to the conclusion that a more scandalous bit of work in putting up electric light was never done by anybody. He knew how injudicious it was for counsel to open a case by overstatement. But in this instance he was not putting his case too highly. There was nothing safer than the electric light if care was taken in the installation. There was nothing more dangerous than neglecting the fundamental rules of prudence in arranging the installation. He felt convinced—he doubted whether it would be controverted—that all the good sound rules which were absolutely necessary for protection in using so subtle and so useful an agent as electricity, were neglected. After speaking of the general rules that governed sound work, and speaking of the faults that were found in this installation, witnesses were called.

Mr. Chamberlayne said he was engaged by the plaintiff to manage the exhibition of the picture at 80, Strand. He was present most of the time while the work was being carried out. Most of the electrical work was done by two boys. Occasionally another man was in attendance. All this time the picture was in the office. Messrs. Shoolbred's men placed the picture on the frame. An attempt was made to light up the picture in June, when the light was proved to be insufficient. Zinc reflectors were then put up. Eventually a 100 and a 50 candle-power lamps were put up, and on June 29th the picture was ready for exhibition. On the 30th there was a very successful opening day. July 1st and 2nd were private view days. On the Friday, however, some of the public were admitted. There were two oil lamps at the bottom of the room. All the electric lights were focussed at the top of the room near the picture. The exhibition continued open five days. A little after lunch time on the 10th the fire broke out. The poster outside would not light up. The men were there attending to it up to the day of the fire. On the day of the fire about 80 of the public were present. The takings were entered daily, and could be produced. On the Monday they were over £6, Tuesday and Wednesday over £8, Thursday over £11, Friday over £9. On the Saturday part of the money was lost, owing to the fire. The total amount taken to Friday night for admission and sale of photos was £54 10s. The light failed several times during the week. The first time it went out witness found one of the fuses had blown. He replaced it, and the light re-lit. On the next occasion he sent for the electrician from the Hotel Cecil. Witness wrote to Messrs. Shoolbred complaining of the defective light. A man came down, and after examination suggested that the poster lights should not be lighted. The fuses were then strengthened. After this the light went on very well. On Saturday, just before the light went out, witness was standing 6 or 7 yards from the picture talking to a visitor. Suddenly the light went out. Almost instantaneously there was a flash like a flash of lightning at the right-hand corner of the room, near one of the reflectors. The whole of the curtains and drapery took fire. With his wife's assistance he tore down the drapery near the picture. He next tried to get the picture down, but without success. With other help he eventually got the picture out of the frame, and bundled it out of the door. The picture was torn and scratched. Some of the figures in it were practically unrecognisable. Mr. Weblyn came on the scene and ordered witness at once to telegraph to Messrs. Shoolbred. The following Monday experts were sent down to try and find out the origin of the fire. In his opinion the fire was caused by the electric lighting.

Cross-examined: He had not seen the dark man who was employed by the plaintiff in the room that day. Two days before he had been discharged for taking too much liquor and for being rude. On the Saturday, however, he was taken on again. When the fire broke out he believed the dark man was changing his uniform, but he could not say for certain. The room was adjoining the exhibition room, but there was no communication between them. He was not that day under the influence of drink. He had been taken on again because he was most useful, and had promised not to offend again. The little tables were never moved. They were never within 20 feet of the picture. An ordinary oil lamp was standing on each table. They were used to show the photos of the picture. He denied telling the chief of the salvage corps that he did not know the cause of the fire.

Thomas Macaulay, a black man, said he was accustomed to act as showman to exhibitions of the present kind. He was dressing when the fire broke out. He ran out into the Strand and summoned a policeman. Afterwards he assisted in getting the picture out of the room.

Cross-examined: He had a tiff with Mr. Chamberlayne on the Friday before the fire, owing to having taken an extra glass of beer. Mr. Chamberlayne discharged him, but the next afternoon, after apologising, Mr. Chamberlayne took him back.

The hearing was adjourned.

At the resumed hearing on Thursday expert evidence was called to speak to the nature of the installation.

Mr. Tate, an electrical contractor, said he was asked to go and see the scene of the fire at 80, Strand on Wednesday, July 14th. After speaking of the appearance of the room, witness said he next examined into the electric installation. Outside there were six posters, one of which was produced. They had brackets for lamps, which should have been fixed, but were not. The wires were fixed to the poster by staples, quite a wrong way of doing the work. The insulation on the wire was of rubber. Where the staples bridged over the wires they were liable to cut through the insulation. If they did so a short circuit would be set up, which would occasion a large rush of current through the wires. If the staples were tight on the copper over two wires, the safety fuse would be blown, and not much damage done. But if the staples only cut through one wire, and another staple cut through an opposite wire, there would be great danger. It was a most unsafe method of putting up wires. He would not even adopt it in fixing bells, where the current was very feeble, and from a small battery. If the short circuit was not strong enough to blow the fuse, the probable result would be a fire. The bracket consisted of a brass plate screwed on to the wood of the frame. The wires were drawn into the bracket, which was screwed against the picture pinching the wires. That piece of work was a most negligent way of doing business, and most dangerous. The end brackets were so arranged that the lamps stood upright. When he took the poster down he said the water had got into the holders, and the lamps dropped off. The work must have been done by boys without proper supervision. In the main switch the wires must necessarily be brought near to one

another. It was made of brass plates mounted on to a porcelain base. The wires were soldered into plugs. The insulation ought to be brought up as close to this work as possible. In some cases he noticed a small amount of rubber had been put on to the wires. In one case the rubber had not been put on, and the wire was quite bare. The mounting of the switch was not itself at all a proper one. It should have been mounted on a mahogany board instead of on a piece of rough boarding. Even where the rubber was put on it had not been put on properly. Such an insulation would be likely to break down in the case of damp. Even if it had been temporary, it was a wrong method. There was a total neglect of every precaution. In the cases of the smaller switches the wires were bare as they entered, which was an improper arrangement. The leads from the switches were made of a single 14 wire. Ultimately it was joined to flexibles, which were two separate cables of small wires, insulated with layers of cotton, rubber, and silk on the top of all. They were then twisted together to bring the leads down together. The flexibles belonged each to a lamp. That junction was made by twisting the ends together. The single 14 copper wire was just twisted round the other wires. Such a joint ought never to have been made. Flexibles should be brought to a "cut-out." They ought never to be bunched. Apart from the absence of a cut-out the joint should not be effected in that way. Such a joint was dangerous. In proper work the joining would be effected by soldering. In the method adopted by the defendants there were several loose ends, which rendered them liable to occasion a fire. There was no casing above the juncture. The wires were all tied up together. The reflector hung from a flexible, and so hot was the lamp that it melted the soldering. Holes had been punched upwards through the reflector, through which the flexibles were suspended. That was a most improper way to conduct flexibles through a metal sheet. The proper way was to pass them through wood. The effect of the rough metal edge would be to cause a short circuit. In his opinion, the most ordinary care had been neglected. In an installation properly carried out there was no danger. The main fuses were composed of the ordinary fusible metal, but the fuses would require three times the amount they carried before they would explode.

Cross-examined: He should say the fire was occasioned by the way in which the flexibles were arranged. Any one of the knots of the flexibles resting on the rough metallic edge might have caused the fire. The insulation at the point of contact with the metal might have broken down. Heat would be generated, which might end in fire. The insulation would break down by being physically destroyed. The result of bringing a positive and negative wire together would occasion a short circuit. The current then found a point of contact at the break in the insulation, and heat was set up. Assuming the currents only made partial contact together, there would be heat and a flame. If the current were small, the fuse would not blow. The danger of a short circuit was an increase of temperature, and an outbreak of sparks. The fuse should be an adequate protection. To get a fire at the spot, he suggested the insulation must be affected, and there must be a fuse which did not blow. That condition must be sufficiently long to fire the drapery. But the insulation itself was of inflammable stuff, and would itself light up and communicate itself to the objects around. The risk the flexibles ran by contact with the metal surface was that they would be cut through and cause a short circuit. Rubber insulation would stand a good deal, but it was not proof against rubbing by a sharp metallic edge. The great importance of securing a smooth edge arose in the case of swinging lamps. If the bracket were a fixture, the necessity of this would be diminished. Where the flexible was perfectly stationary, and the metal edge was stationary, of course there would be little danger. When he made the examination, all the wires except two or three were in position. The two or three had burned off and dropped down. The silk of the remaining wires was rubbed off. He had not experimented with the wires to see the amount of current they would carry. 18 or 20 amperes might be got through without firing the insulation, but it would be ruined; but it would not necessarily destroy the fuse. The fuse he produced would carry 25 amperes. The heat from the lamp might be radiated from the reflector and destroy the insulation. He could not point to a place and say that there the insulation was destroyed and the fire occasioned. If the fire were electrical it would originate at some spot above the reflector. That being so, it will be the drapery above the reflector that it would communicate with. That drapery would show most of the signs of fire, which actually happened. If the fire had been below the reflector the insulation would have burned away close to the lamp, instead, as was the case, away from it. Of course, this would be affected by the direction of the fire. In his opinion the fire was occasioned by bad workmanship. He suggested that the ordinary precautions could be as easily effected in a temporary as in a permanent installation, and were as necessary. A dry joint—that was to say, an unsoldered one—should never be made. The measure of prudence was the measure of price in the case of short installations by small contractors.

Re-examined: Dry joints were made in experimental work, but they were always under observation.

Mr. JAMES SWINBURNE said he had examined 80, Strand, after the fire of July 10th. He observed that the wiring had been very badly carried out. He thought the fire was caused electrically. The position of the fire led him specially to come to that conclusion. The fire had broken out in the neighbourhood of the wires. There was no ventilation to the reflector; therefore, heat was allowed to accumulate. As to the flexibles, he agreed with the last witness throughout. Such an installation as this should have been done with particular care. The wires lay among inflammable material; they were brought near the ceiling, and the room was stopped up so as to exclude the air.

Cross-examined: He did not think the flexibles were looped up clear of the holes through the reflector. His recollection was, that they were lying on the reflector. He could not say exactly how the fire was caused. Probably the heating of the reflector was contributory—ventilation being excluded from the room there would be little motion from air. Electrical fires were difficult to account for; they occurred in so many different ways. In this instance, if it had not occurred in one way, it would have been pretty sure to occur in some other way, sooner or later, owing to the manner in which the installation had been carried out. He was asked to form an opinion as to whether the fire was electrical. He came to the conclusion that it might very easily have been electrical. In his opinion, the class of joint employed was improper for a temporary installation. Such a joint could be used only in experimental work, where it was being watched. He would not use such a joint even for an installation of a week. Such a joint would work loose; that involved the whole thing. Working loose, it would occasion sparks. That was the real objection. The joints were taped over. The fire would most easily be occasioned if a high number of amperes were passing through the wires, but it might occur to a low number.

Re-examined: If the wires became dirty they would be likely to spark. They must be kept close and clean at the joint.

Mr. R. RALPH, an electrician, in the engineers' department at the Hotel Cecil, said that in June last year he received instructions to supply an extra current to the premises, 80, Strand. The supply was to be 20 amperes. He carried out the necessary work of laying the cable. Some days after putting the current in, the fuse, which carried 20 amperes, blew. He put in another, which also blew. Witness put another in. After that the supply was increased to 25 amperes, and a fuse to carry 25 amperes was put in. That lasted for some time, but it at length blew. He inserted another. Nothing further happened till the Friday night previous to the fire, when this fuse blew at 5 in the afternoon. It had not been in for half an hour when it blew. Another was inserted, but at 9 p.m. it again blew. Witness said he could not understand this frequent blowing of fuses. He told Mr. Chamberlayne that it was very funny the fuses were continually blowing. Mr. Chamberlayne said it was their fault. Witness said they were supplying 25 amperes, which had been asked for. He found the current passing was 22·5 amperes, and the fuse blew at 25. He told Mr. Chamberlayne there must be something wrong. One of Mr. Shoolbred's men was there, and he also told him that something was amiss. Before leaving he put in another fuse. The next thing he heard, on the Sunday morning, was that there had been a fire. He was familiar with the way electric fittings should be put up. Generally, he was of opinion that the installation had not been carried out in a proper way. He was certain the rubbering of the flexible against the reflector would cause the insulation to come away. After what had occurred, the blowing of the fuses, he had come to the conclusion that something was wrong. When he inspected the "cut-out," he found that the wires were fused to 40 or 50 amperes.

Cross-examined: If he had thought there was a fault with the installation, it would have been his duty to report it. As the men were still working on the job, he thought there might be a temporary shortage. He thought the reflector got hot from the wires where the current entered. If the heating were equal throughout, there would be no reason for the insulation being destroyed merely at one end. But if there were a 100 candle-power at one end, and a 16 candle-power at the other, there would be every reason for the destruction of the insulation at one end and not at the other. He had had no experience of insulation being destroyed through heat. He never knew a case of the rising of temperature destroying the insulation by mere heat.

Re-examined: When men were working at an installation with the current on, there was danger of a short circuit. He could not suggest any cause for the fire other than an electrical one.

Mr. MORGAN WILLIAMS, another electrical engineer, said he had superintended many installations, and had been consulted by local authorities on these questions. He inspected 80, Strand, premises on July 16th. He came to the conclusion generally that the electric light work had been very badly done, and was in opposition to the manner in which such work was generally carried out. The system of supporting wires over a reflector which acted as a sort of grill, was sufficient to destroy the insulation. Generally speaking, he thought it was highly probable the fire was occasioned by faulty workmanship. The grouping of the joints was especially bad. The wires were simply twisted, and in no way made mechanically perfect. If the insulation were ignited it would cause the surrounding material to light. This would be occasioned by a short circuit or over-heat. The surroundings of the installation made it imperatively necessary to carry the work out in a particularly careful manner. The price charged was adequate for doing the work in a perfectly permanent way. On the general principle he agreed with the other witnesses.

Cross-examined: He suggested that the heat generated by a dry joint would be sufficient to cause a fire. He had often known of a fire caused by a short circuit. For his theory of a short circuit there must be a leakage of electricity at a joint. The wires were not welded together; they were simply twisted. If India-rubber were well wrapped round it would prevent leakage as long as it lasted. He thought that a slight failure in any of the joints would have developed so rapidly, owing to the heat, as to have disturbed the position of the twisted wires. They had not been put in such a mechanical position as would be likely to allow their remaining intact. It was quite probable that these defects should be developed in a short time. There was no more reason why the fire should break out in one joint than in another. It was equally likely to break out at any one of them. At 17 defective joints there were 17 causes for fire. There was nothing to have prevented seventeen fires.

Mr. BURSTALL gave similar evidence.

The hearing was adjourned till Friday.

The hearing of the action was resumed on Friday last.

Further evidence was called to describe the nature of the fire. Plaintiff then spoke to the amount of damage he had sustained by reason of the fire. He estimated that he had lost £100 a week during the 40 weeks in which the picture had not been on exhibition. Andrea Landini, the artist who painted the "Royal Harem," the picture in question, estimated its value at 30,000 francs, or about £1,200. The fire made great havoc of the picture. It was sent out to him in Florence, and he repainted it. The picture was nevertheless depreciated from its original value by about £200. Fabro G. dei Marcovaldi, a Florentine gentleman, spoke of the reputation of Andrea Landini in Florence. This concluded the plaintiff's case.

Mr. Lawson Walton, for the defendants, said it was necessary for the plaintiff to establish that the negligence charged against Messrs. Shoolbred was the cause of his loss. Then he must make out that he had, in fact, sustained the damage he claimed. It was quite possible that the work in connection with the installation, judged from a high standard, was open to criticism. It did not follow that the defects indicated were the cause of the fire which injured the picture. It was not for the defendants to establish that the fire was not electrical. It was for the plaintiff to establish that, inasmuch as the main question was whether the fire was electrical or not, he proposed to invite the learned Referee to consider whether the plaintiff had succeeded in proving the electrical origin of the fire. He would then ask the Referee to consider one or two arguments and some evidence with a view to showing that it was impossible for plaintiff to establish such a case. The picture actually sustained no damage from the fire. It was owing to the rough handling it received. Very little outlay and very little time would have been necessary in order to have restored the picture and to have re-opened the exhibition. But the plaintiff evidently thought that an action against the insurance company, and afterwards against Messrs. Shoolbred, would be more remunerative than the exhibition. The fire had to be connected with an electrical cause. No one was more ingenious, or more capable than his learned friend, Mr. Moulton, in putting his finger on the electrical cause, if it were possible to indicate it. Some of the most qualified electrical engineers had been called to indicate the cause of the fire, but they all admitted it was impossible to define precisely the particular cause. Surely it was a cardinal weakness in the plaintiff's case, on whom the onus was to establish the electrical cause of the fire, to say that while there were several possible causes, they could not pretend to say which one it was. The plaintiff's case was that the flexibles above the picture became heated. They became incandescent, and burned, and the drapery in contact with them. That was the theory. How was it proposed to be established? There was one main question: Was it shown that there was any short circuit? Without a short circuit there could be no cause of fire. He submitted that the plaintiff had failed to prove that there had been a short circuit. There was not a shred of positive evidence to indicate either that at the joint or at the point of contact of the wires with the reflector, there was a failure of the insulation which would have caused leakage, and which might have ended in short circuiting and setting up a cause of fire. There was hypothesis heaped on hypothesis, but there was no basis for this in actual observation. From the evidence he deduced these facts: The outbreak of fire followed the loss of electrical current through the wires. If the light went out the connection with the main was destroyed. The meaning of the light going out was that the fuse had blown. There was no electrical current passing through the wires at all. Then the origin of the fire could not be electrical, because there was no electricity to occasion it. The presence of fire had not manifested itself, therefore it must be taken not to have originated until after the electrical connection with the main had been cut off. Therefore the electrical origin for the fire had been cut off. Plaintiff thus entirely failed to make out an electrical origin to this fire. The alternative was ignition by some other means. The learned counsel suggested that the light having failed, use was made of the two oil lamps at the other end of the room. One of these might easily have been placed on the pedestal near the picture. What more natural than it should have fired the drapery around. This would explain the scorch on the partition, and, indeed, the whole outbreak. It did away with all the difficulties surrounding the other explanation, that of electric origin. He asked the learned Referee to come to the conclusion that the plaintiff had failed in his action. Evidence was then called.

Major Charles Fox, Chief of the London Salvage Corps, gave evidence as to what passed between himself and Mr. Chamberlayne at the time of the fire.

Mr. S. E. Pagett, an artist residing at King's Langley, said he had been in the habit of exhibiting at the Royal Academy. He had seen "A Royal Harem." In his opinion it had no artistic value.

Mr. Edmund Charrington, A.M.I.C.E., said that he had had 16 years' experience in electrical engineering. Defendants engaged him to make an examination of the scene of the fire. He found a mark of burning just above the pedestal, near the picture. It was deeply charred at the bottom, but died off to nothing. There were two oil lamps in the room. One of these he measured. He found the measurement of the lamp from the base to the top of the chimney coincided to the distance from the top of the pedestal to the bottom of the charred mark, when tilted. He examined the installation connected with the reflector. The flexibles were slung 3 inches above the reflector with insulating tape, where the fire had not played. Where it had played they were lying on the reflector. He next examined the fuse boxes. In each case a fuse had blown on one pole. The materials used for insulation were excellent. The flexibles hung through; the reflector made the silk of the insulation slightly roughened, but that was all. There would be no reason for the rubber perishing. For the purpose, he thought, the installation had been sufficiently well carried out. It was out of the question for the insulation of the flexibles to be injured by vibrating against the burred edge of the reflector. Having examined the joints, he was of opinion that the wires were too tightly twisted to permit of the arcing that had been spoken of.

The case was adjourned till Monday.

On the resumption of the hearing on Monday, the examination of Mr. Charrington was continued.

The Witness was questioned on the subject of heat, arising from an arcing at the joints. From the main switch the branch mains, three in number, came up above the reflector. Several inches above the flexibles were joined on. There were three pairs of joints. In fact, there were six joints in all to the flexibles. There was no joint more injured than the one produced. On those that were not burned the insulating tape remained, and the joints appeared quite tight. The jointing was quite sufficient for the purpose. He did not believe that in any of them the arcing suggested by the other side would have been set up. It was not possible, in his opinion, for the heat above the reflector to have become so great as to cause combustion. The fire office allowed the temperature to be raised to 130° F. He did not think the heat would be appreciably higher at one end of the reflector than at the other. The heat would be diffused. As a matter of fact, the reflector would not concentrate the heat. It would diffuse it. He did not think that anything but an extraneous fire would have injured the flexibles at one end, and left intact those at the other. If combustion had set in at one end of the reflector, he should expect to see the flexibles injured at the other end. He had examined the amount of electrical energy passing along the wires to the lamps, and it did not appear to him to be great enough to raise the high temperature that had been suggested.

Mr. T. E Gatehouse said his theory was that the fire originated in the ignition of the curtains near the picture from an oil lamp placed on the bracket near. The wires were too good to allow of leakage. As far as he had observed it, the installation would pass muster. It was unenclosed, and could easily be got at. In the case of a permanent installation it was necessary to make soldered joints, but it was certainly not necessary for a temporary installation. Especially was it unnecessary when frequent re-adjustments were made.

In reply to the Official Referee, he said it was most usual to employ soldering for the joints, but an unsoldered well made joint was quite safe for three months.

Mr. Gatehouse was examined and cross-examined at great length on the theories advanced by the plaintiff's witnesses, with all of which he disagreed. His contentions were made on the results of experiments he had carried out with flexibles, unsoldered joints, and the heat which is given out from incandescent lamps under various conditions.

The hearing of the case was concluded on Tuesday afternoon, when the Learned Referee intimated that he would reserve his decision.

Action against the Corporation of Worcester.

Last week, before Mr. Justice Bigham, sitting as an additional Judge of the Chancery Division, the hearing was continued of the action brought by Mrs. Hadley, of Leigh House, Worcester, against the Corporation of that city, for an injunction restraining them from continuing the nuisance alleged to be caused by their works for lighting the town. Mr. Henry Lea, senior member of the firm of Messrs. Henry Lea & Sons, electrical engineers of Birmingham, deposed to visiting the plaintiff's house in March last when he distinctly heard the noise of the machinery at the defendants' works. For the defence, Mr. Henry Joel, Mr. W. H. Preece, C.B., and other engineers were called to prove that the defendants' works were properly constructed to prevent noise and that no appreciable noise was caused. Mr. Justice Bigham expressed the opinion that the case ought to have been commenced in the Queen's Bench Division, and heard at the Worcester Assizes, so that the jury and the judge could have visited the *locus in quo* themselves, and have personally decided whether the works did constitute a nuisance. On the evidence before him he came to the conclusion that the plaintiff had not made out her case, and gave judgment for the defendants with costs.

Arnold & Co. *v.* Goossens, Pope & Co.

At the Newport County Court on Thursday last week an action was heard in which Messrs. Arnold & Co. (Newport) sued Messrs. Goossens, Pope & Co. (Liverpool) for damages for breach of contract, the amount being £11 10s. 4d. Mr. W. Lyndon Moore appeared for plaintiff, and Mr. F. Gardner defended.

According to the plaintiffs' case they had to supply the electric light fittings for the Newport Lyceum when it was about to be opened last autumn. They placed the order for a number of lamps with the defendants, but there was some default on their part, and lamps had to be obtained from London. Through the delay, too, plaintiffs' men were obliged to work all day on a Sunday, and extra pay had to be made for this. Plaintiffs' representative said that he arranged with the defendants to have the lamps supplied in time for the opening.

Mr. Pope, called for the defence, said it was impossible to get certain coloured lamps from the glass-blowers by the time plaintiffs wanted them. Plaintiffs' representative allowed for this, and did not demur, and the order was sanctioned notwithstanding.

His Honour said he thought the plaintiffs were entitled to recover. He thought, however, that too much had been claimed for labour. He gave judgment for £8 10s.

Donnelly *v.* Egan & Son, Limited.

Before the Vice-Chancellor at Dublin last week, Dr. Donnelly, of 14, Rutland Square, Cork, sought an injunction to restrain defendants, who are jewellers, carrying on business at 32, Patrick Street, Cork, and their servants from keeping, working, or using a large dynamo, gas engine, and electric plant and machinery, on certain premises in Elbow Lane, Cork, at the rear of defendants' establishment to the injury of the plaintiff's adjoining premises. Mr. Ignatius J. O'Brien, with whom was Mr. Stephen Ronan, Q.C. (instructed by Messrs. John L. Scallan and Son), moved on behalf of the plaintiff for an *ad interim* injunction to prohibit the using of the machinery pending the hearing of the action, relying on an affidavit of plaintiff stating the injury the vibration of the machinery was causing plaintiff's premises, and that defendants had specially covenanted by the lease under which they held the premises in Elbow Lane not to use machinery therein to the annoyance of their neighbours. Mr. George Wright, Q.C., on behalf of the defendants, stated that he could not resist the motion, but it should be limited to the large engine and machinery recently placed on the premises, and the action not to be further proceeded with. Mr. O'Brien consenting, the Vice-Chancellor made an order accordingly, and directed defendants to pay all plaintiff's costs to date.

Brown *v.* Edinburgh Corporation.

Lord Low, in the Court of Session last week, heard proof and disposed of an action by Andrew Betts Brown, hydraulic engineer, 19, Douglas Crescent, Edinburgh, against the Town Council of Edinburgh, as undertakers under the Edinburgh Corporation Order, 1891, for £143. In 1895 pursuer received current from the defenders at 115 volts. In 1896 he said he received a letter from the engineer asking him to allow the defenders to change the voltage to 230 volts. At the same time it was intimated that they were willing to exchange the old lamps for the new ones, and undertook to make any alteration on the wiring of the pursuer's house that might be required, free of cost. Pursuer said that he would not consent to the change unless the defenders paid the entire expense. Pursuer averred that the old wiring was not renewed or sufficient for the increased voltage. Defenders pleaded that the pursuer's fittings were defective, and that they had never undertaken pursuer's installation even for 115 volts, and that they had carried out all the alterations required to adapt the wires for the increased voltage. His Lordship found that the Corporation had failed to carry out the contract they had undertaken, and gave pursuer decree for the amount sued for, with expenses.

CORRESPONDENCE.

Arc Lighting.

The letter from the Brockie-Pell Company which appeared in your last issue calls for some reply.

The fact we intend to emphasise by the advertisement in question is, that we are still, as we have been for many years, the leaders in all that pertains to arc lighting, and we do not think that any remarks of interested parties will alter this.

Brockie-Pell is merely a trade term, and refers to no particular design of lamp, as, to a dozen or more makes of lamps which we have issued from time to time, this generic title has always been applied.

It is true we no longer use this trade term, but our present lamps are a distinct advance on anything made before—a statement which receives ample confirmation from the abnormally heavy orders which we hold for them at the present time.

Johnson & Phillips.

Induction on Telephone Circuits.

As I should like to know if the following plan would be of any service in reducing the induction on ordinary single wire circuits where the zig-zag system would be too expensive or inconvenient, I should be obliged if you would insert this in an issue of your paper, in order to elicit a reply from some of your correspondents.

I would suggest that a wire be run about equi-distant from other lines on poles, say, about centre cross-arm and close against pole, and not on insulators, but connected at each pole to earth (if wood poles) to the lightning conductor wire, and (if iron) to the poles themselves; would not this collect most of the induction, and also act as a protection in cases of slight electrical atmospheric disturbances, and thus facilitate working of lines.

If any such system has been tried, I would be glad to know result of same.

F. P. Selby.

Newcastle, New South Wales.

[Such an arrangement would be absolutely without effect. —Eds. Elec. Rev.]

Electricity in Italy.

With reference to your note "Electricity in Italy" it may interest you to know that the business of the "Società Co-operativa" mentioned therein, is about to be transferred to the British Continental Electricity Company, Limited. I quite agree with Mr. Keene that there is a vast field opening for English engineering enterprise in Italy, and the question at the end of the paragraph is one I have often asked, but never had satisfactorily answered.

W. A. Brodie,
Managing Director of the British Continental Electricity Company, Limited.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending July 19th, 1897.	£	s.
Adelaide	104	0
Aden	10	0
Alexandria. Teleph. mat.	29	0
Amsterdam	90	0
„ Teleg. mat.	85	0
Antwerp	40	0
Bombay	10	0
Bordeaux	40	0
Boulogne	13	0
Cadiz	30	0
Calcutta	66	0
Cape Town	40	0
Colombo...	226	0
Durban	235	0
East London	131	0
Gibraltar	1,000	0
Halifax	50	0
Hong Kong	56	0
Launceston	52	0
Madras	55	0
Malta. Teleg. mat. ...	123	0
Otago	6	0
Passages...	382	0
Penang	19	0
Port Chalmers	235	0
„ Elizabeth	22	0
Rangoon	70	0
„ Telephone ...	44	0
Shanghai	14	0
Singapore	31	0
„ Telephone ...	28	0
Smyrna. Teleg. mat. ...	36	0
Sydney	1,116	0
Wellington	32	0
Total	£4,502	0

Week Ending July 19th, 1898.	£	s.
Alexandria. Teleg. mat.	12,551	0
Amsterdam	155	0
Bahia Blanca. Teleg. mat.	288	0
Bangkok	13	0
Barcelona	400	0
Bilbao	20	0
Bombay	13	0
Bordeaux	22	0
Boulogne	141	0
Buenos Ayres	61	0
Calcutta	42	0
Cape Town	1,152	0
Copenhagen. Teleg. cable	49	0
Durban	195	0
„ Telep. mat. ...	40	0
Fremantle. Teleg. mat.	211	0
Gothenburg. Teleg. mat.	181	0
Halifax. Teleg. mat. ...	138	0
Hamburg. Teleg. mat. ...	36	0
Hong Kong	21	0
Lisbon. Teleg. mat. ...	96	0
Mackay	4,200	0
Malta	10	0
Marseilles	81	0
North Atlantic. Teleg. cable	11,400	0
Port Elizabeth	181	0
Rio Janeiro	19	0
Santander	450	0
St. Petersburg	61	0
„ Teleg. cable	156	0
Singapore. Telephone.	22	0
Stockholm Teleg. cable.	2,014	0
Sydney	1,378	0
Trinidad	33	0
Wellington	139	0
Total	£35,973	0

Foreign Goods Transhipped.

	£	s.
Odessa	17	0

Ariel Arc Lamp Syndicate Liquidation.—Under the liquidation of the Ariel Arc Lamp Syndicate, Limited, the meeting of the creditors and shareholders were held last Tuesday at the Carey Street offices of the Board of Trade. Mr. A. Wheeler, Official Receiver, reported that the company was formed in August, 1894, with a nominal capital of £20,200, increased in the following December to £24,200 by the creation of £4,000 accumulative preference shares. It was promoted to acquire the patent rights of an invention for improvements in electric arc lamps. The promoter was Mr. S. Sealy Allin, who was also the vendor jointly with Mr. C. Graham Lloyd. The purchase price was fixed by the vendors at £19,000, payable in shares, and the working capital of £1,000 was provided by Mr. Lloyd, who took shares in return. The lamps were manufactured by Mr. Allin, and experiments were carried on with a view to perfecting the mechanism of the working of the lamp, but owing to difficulty in getting the lamp properly manufactured, the company was handicapped and the lamp did not have a fair trial. Reports were obtained from Prof. Silvanus Thompson and Mr. T. H. Medhurst, both of whom reported favourably upon it. Patents were taken out in Great Britain, France, Belgium, United States, Germany, Italy, Austria, Hungary, Canada, Switzerland, and Spain. The British patent were reported upon by Mr. Terrell, Q.C., and Mr. Imray, both of whom pronounced it to be valid. Efforts were made to form a company to take over the patents and manufacture and sell the lamps. They were successful up to a certain stage, but ultimately fell through, and the syndicate had been unable to dispose of its patent rights. The failure of the syndicate was attributed to

want of working capital and inability to get the lamp properly manufactured. The accounts filed under the liquidation showed liabilities £429, and assets £102; the chief item being the patent, valued at £100. The deficiency to the shareholders was returned at £20,329, and was explained by the patents having been written off (£19,000), and various other items. The Official Receiver was deputed to act as liquidator, assisted by a committee of inspection.

Bournemouth Tenders. — In regard to the list of tenders in last week's REVIEW, for the Electric Lighting Contract No. 1 of the pier, pleasure grounds, and winter gardens at Bournemouth, Messrs. Warburg Dymond & Co., write stating that the price of their tender was £2,035. They add that the average of the tenders sent in is about £2,160.

Change of Address.—Messrs. Green & Boulding, engineers, are removing from 21, Featherstone Street, City Road, E.C., to more extensive premises at 105, Bunhill Row, E.C.

Church Lighting.—Mr. H. G. Andrews, of Boscombe, has obtained the order for the electric lighting of the church of St. Clement, Bournemouth.

Mr. F. Willey, J.P., of Bradford, has generously provided an installation of electric light for Blyth Church, and will supply the electricity free of cost from his own generating plant at Blyth Hall.

Dissolution of Partnership.—Messrs. C. W. Baxter and C. Wray, manufacturing opticians and electricians, carrying on business as Baxter & Wray, at Borough Mills, Bradford, have dissolved partnership. Mr. C. W. Baxter, who will continue the business, will attend to debts.

Electric Power in Cork.—The large power station in Cork is now complete, and in a few days the electric current for lighting, both public and private, will be available. The British Thomson-Houston Company have erected three 200-kilowatt machines for lighting the city and driving machinery by electric motors. The electricity is produced from steam boilers supplied by Messrs. Babcock & Wilcox, and the motors have arrived from America to drive the machinery of the Cold Storage and Ice Company, South Mall, Cork. The steel shaft came from America, and it has been erected by Mr. Maitland, Pennsylvania. The whole installation has been carried out most successfully by the resident chief engineer, Mr. Mertz. The *Constitution* Newspaper Company are getting motors to drive their linotype machines.

New Electrical Department.—Messrs. Jas. Kilpatrick and Son, plumbers and lead merchants, Dyer's Wynd, Paisley, have opened an electrical department in Terrace Buildings, High Street, under the management of Mr. Robt. Foulds, late of Liverpool, as contractors for electrical installation and apparatus of every description.

Fairplay v. Monopoly.—In view of the second reading of the Bill promoted by the General Power Distributing Company, which is now pending in the House of Commons, the Liberty and Property Defence League has just issued a pamphlet under the above title. The objects of the Bill and the arguments in favour of it are discussed.

G.P.O. Factory.—The General Post Office have completed the additions to the instrument factory, Bovay Place, Holloway, and the new red brick building faced with stone, built in the usual substantial way, is in full working order for the making of electrical apparatus.

The Jandus Lamp.—Messrs. Drake & Gorham inform us that the Jandus lamp has been selected for lighting the Bon Marché, Brixton. Over 200 lamps will be supplied. We are also informed that the Jandus Arc Lamp Company, which claim to be the pioneers in the enclosed arc lamp industry in England, has, after a number of experiments, solved the difficult question of running five lamps in series, thus rendering the Jandus lamp still more valuable for town lighting purposes.

Liquidation Notices.—A meeting of the New Telephone Company is to be held at 2, Suffolk Lane, E.C., on Monday, August 22nd, at 12 o'clock noon, to hear an account of the winding up operations from the liquidator (Mr. Albert Anns).

Creditors of the Cowper-Coles Zinc Extraction Syndicate should send particulars of their debts or claims to the liquidator, Mr. T. S. Lowry, Bank House, Camborne, by August 16th.

Luxfor Prisms.—The lighting of town buildings into which, under ordinary conditions, only a deficient amount of daylight penetrates, is a problem that has received considerable attention of late years, but hitherto it can hardly be said to have been approached in a scientific manner. The outcome of much patient study of the properties of reflection and refraction, and the principles involved in the diffusion of light, has resulted in the production of what are called Luxfor prisms. The American Luxfor Prism Company, of Chicago, has not been long in existence, but its work in the way of lighting up dark buildings, basements, workshops, and other enclosed areas has been so remarkable, that a British Luxfor Prism Syndicate has been formed to work the invention in this country. Large premises have been taken at Hill Street, Finsbury, where recently we had ocular demonstration of the extraordinary properties of these prisms. A narrow room on the ground floor is 92 feet from front to back. On the inner side of the window, through which the light from the street enters, frames of Luxfor prisms have been fixed on hinges, so that they open casement-wise. In this way the effect of the light through the plate glass only can be compared with that when the prisms are interposed. The projection of light by means of the prisms was most marked, the amount thrown on the end of the room, 92 feet distant, being such as is quite unattainable by any other means. It was clearly shown that in many buildings the use of these prisms would result in a great increase in comfort, in a material reduction of expenditure on artificial light, and in an addition to the rental value of the property. How the invention affects the electric lighting industry will be seen from the following extract from a letter written by the chairman of Idris & Co., Limited: "We are delighted with the effect. The additional light given by the fixing of the prisms in the semi-basements of our factory is startling, and will enable us to do without several gas lights. We had determined to put in an installation for electric lighting during the day in the whole of these semi-basements; but the cost of this will be rendered unnecessary by putting in some more prisms." An interesting feature in the construction of the plates of prisms is the way in which they are put together by a method of electro-glazing. After framing each prism in a strip of copper, and the whole in a brass frame, the joints are first soldered and then the whole plate immersed in a copper depositing bath, the effect of which is that the glass and the copper framing, are, as it were, welded together. The result is a neat plate with the minimum of neutral area, in other words, the least possible weight with the greatest possible prism surface. This system of glazing is a great improvement on the usual zinc or lead framing for cathedral windows as supporting rods, and bars can be dispensed with owing to the strength of plates thus constituted. Windows built up in this way are also thoroughly wind and water-tight.

New Premises.—Messrs. Palmer & Watson are about to open premises at 100, Charing Cross Road, W.C., as electrical engineers.

Partnership.—Mr. F. F. Bennett, consulting engineer, 13, Victoria Buildings, Manchester, has taken Mr. W. H. Walley into partnership, and the name of the firm in future will be known as Messrs. Bennett & Walley.

Patent Laws in Finland.—Messrs. W. P. Thompson and Co., Manchester, write as follows:—The State of Finland has now, following the precedent set by several of the European kingdoms, promulgated a new patent law which in many respects is more liberal than the old one. Patents will now be granted for 15 years for any new invention with the exceptions of articles of food, drink, wear, medicines, or chemical substances. Inventions, however, for a new process of manufacturing these can be patented. The granting or publication of a patent abroad will not prevent the grant or issue of a Finnish patent, provided the application therefore be made within six months of such publication. An annual tax will be payable upon the patent when granted, commencing at about £2, and increasing periodically to about £4 10s. Three months' grace is allowed for the payment of such taxes before the patent becomes void. Within four months after publication of the patent, anyone may enter opposition to the granting of it on the ground that the invention is not new or that the invention was fraudulently or illegally obtained from another person, or that the patentee has not the sole right to the invention, and in either of the latter cases the aggrieved person may claim the patent. The invention must be worked in the country within three years of the date of the patent, or otherwise the patentee is bound to grant licenses to other persons to work it. An assignment must be filed at the Finnish Board of Trade and entered in the Register of Patents. The proprietor of a patent granted under the existing law may apply for a new patent for the unexpired term of the existing patent.

Soldering Irons.—Messrs. W. Tasker & Sons, Limited, electrical engineers, of Coventry, send us a list of the "Moto" soldering iron, which they have been for some time using in connection with their contract work. The iron is intended for telephone and telegraph fitters, as well as plumbers and tinsmiths.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Gas and Electric Lighting Committee has selected four of the applicants for the post of electrical engineer, and will put the names before the next Council meeting.

Alloa.—The Burgh Commissioners had the question of applying for a provisional order before them last week. Bailie Arrol moved that the Commissioners apply to Parliament for a provisional order, and said that the first scheme which he proposed was simply to light the streets with electricity at a cost of £3,000, but this was not considered satisfactory. They had received an estimate from an

expert for £6,000, which gave 18 street lamps and 1,600 for lighting houses and shops. This also was considered unsatisfactory by the Commissioners, and it was with the view of protecting the interests of the town that he made the motion. He then read a letter received from a firm of solicitors in London, stating that it was the intention of the Urban Electric Supply Company, Limited, to apply to the Board of Trade for a provisional order. The motion was carried by eight votes to three.

Annan.—At a recent meeting of the Burgh Commission, a committee was appointed to draw up a report with regard to the electric lighting of Annan. It was proposed, either to use the old water mill situated about a mile up on the River Annan, which was burned down a few years ago, or to use the old cotton mill in Port Street, which is also driven by water power. When the report came up, however, it was agreed to let it lie on the table in the meantime.

Barrow.—A deputation from the Corporation Lighting Committee visited Lancaster on 14th inst. to inspect the street electric lighting and the station there.

Bath.—Mr. Metzger recently reported that everything was in a very backward condition still as regarded the plant, which was not yet completed, and he hoped all the contractors would be urged to labour their very hardest, or the works could not possibly be ready for the autumn and winter loads.

Battersea.—The Finance and Law Committee reported at the Vestry meeting on Wednesday last week having had under consideration a report of the solicitor, to the effect that the County of London and Brush Provincial Electric Lighting Company had given notice of appeal against the decision of Mr. Justice Jeune in the action of the Vestry against the company for an injunction to restrain the company from using the pipes laid by them in Trinity Road without the permission of the Vestry, and for the removal of the pipes. It will be remembered that the injunction applied for was granted, but suspended for three months, with liberty to apply for a further suspension, if required, to enable the company to make arrangements for carrying the wires in some way other than under the road. The company now requested that, inasmuch as they had given notice of appeal, the Vestry would undertake not to disturb their works, or to enforce the injunction. In the event of an application being made for an extension of the suspension, it was resolved to instruct the solicitor to oppose the motion.

The Vestry, acting on the advice of the Lighting Committee, Prof. Kennedy, and Mr. Peach, architect, has resolved to purchase additional land adjoining the present site for the electricity works, in order to provide for future extensions.

Bermondsey.—On Monday Mr. Cox brought up before the Vestry a special report of the Electric Lighting Committee in regard to the position of the Bill to confirm the Vestry's electric lighting provisional order. He stated that the House of Commons Committee, to which the Bill had been referred, had given its decision that the order for Marylebone should not be confirmed, but that as far as the Bermondsey order was concerned, the opinion was expressed that the Vestry should consider the question in the light of purchase, adjourning the matter in the meantime until the 21st inst. The speaker stated that the Vestry Clerk had drafted a clause for that purpose. It provided that the undertakers (the Vestry) should not be empowered to supply electricity until they had purchased from the London Electric Supply Corporation the distributing mains at a price to be agreed upon between the Vestry and the company, or by an arbitrator appointed by the Board of Trade. The Electric Lighting Committee accordingly recommended the Vestry to agree to the insertion in the Bill of the clause as drawn, or in such an amended form as the House of Commons Committee might consider advisable to grant. Speaking on this point, Mr. Cox stated that the Electric Lighting Committee were not prepared to withdraw their order, and they therefore considered the question as to the cost of buying out the company. According to the evidence given by Mr. Bain before the Committee, the London Electric Supply Corporation had expended about £5,000 in laying distributing mains in the district, whereas in Marylebone £500,000 had been invested. The decision of the Committee practically implied the giving of a monopoly to the electric lighting companies in London and in the provinces, and that was both against the spirit of the times and the resolution passed by the House of Commons. When the Vestry presented the draft clause they would get the provisional order if the Committee were disposed to favour municipalities. The sum of £5,000, estimated as the purchase price, was not large, but even if it were £10,000 it was advisable to effect the transfer, because if the question was delayed they would probably have to pay many times that amount to acquire that part of the company's undertaking in the parish. Mr. Manser having seconded, the Vestry, after a brief discussion, unanimously adopted the recommendation.

Bootle.—The Town Council has accepted the tender of Mr. Walter Musker, Bootle, to erect an electric light station in Pine Grove, for the sum of £6,598. The Council has also resolved to fix the charges for electric lighting on a sliding scale.

Bradford.—At a meeting of the City Council on July 12th, Mr. S. Smith moved a resolution against granting special terms to large consumers of electricity. He claimed that the best policy was to let the public have electrical power as nearly as possible at net cost, and if this were done there would be no room for granting special advantages to large buyers. The consumers in this particular case were the two largest in the city, who took the power both day and night, a very favourable thing for the Corporation. Mr. Smith's resolution did not reach a vote, as the Council was "counted out."

The City Council last week decided to light street lamps at Frisinghall by electricity. The district has, up to the present, been lighted by the Shipley Gas Light Company, which charges a much higher price than the Bradford Corporation does. The Corporation has been greatly pressed to make some arrangement with the Shipley Company, but has failed to do so, and in the alternative has determined to extend the electric cables to these places by degrees.

Brentford.—Mr. Morse has given the Council notice of intention to apply for a provisional order.

Broadstairs.—On Thursday last week the Broadstairs Urban District Council received notices from the Isle of Thanet Light Railway (Electric), and also from the County of London and Brush Provincial Electric Light Company, of their intention to apply for powers to supply electricity for both public and private purposes in Broadstairs and St. Peter's. The letters were referred to the Lighting Committee.

Chelsea.—Some few months ago the Chelsea Vestry proposed to buy all the electrical undertakings in the parish now held by companies. The magnitude of the proposal did not seem to be recognised by them at the time, and one or two members were apparently under the impression that the purchase would be completed within a month or two, and the profits obtained by the companies would be rolling into the coffers of the Vestry to the relief of the rates. But inquiries resulted in quite a different complexion being put on the matter, and the proposal seems to have been allowed to quietly slip into oblivion. However, the Committee that considered the matter has been resuscitated. The Committee considered the advisability of the Vestry obtaining a provisional order, and desired to communicate with the Board of Trade. That authority replied that as there are already two companies under obligation to supply the parish, they would not be prepared to grant further powers. But the Committee recommended the Vestry on Tuesday to forward another letter urging the Board to reconsider their decision, and point out that although two companies are authorised to supply electrical energy in the parish, the supply is practically a monopoly in the hands of the Chelsea Electricity Supply Company, and that the Board have recently granted provisional orders to the Vestries of St. Marylebone and Bermondsey, notwithstanding that private companies are already supplying those districts, and transmitting copies of notices received from the Kensington and Knightsbridge Electric Light Company, and the Metropolitan Electric Supply Company, of their intention to apply for powers authorising them to supply electricity within the parish. The recommendation was adopted. It was further decided to continue the opposition to the Bill of the Chelsea Electricity Supply Company now before Parliament.

Chiswick.—The Works Committee of the District Council had a long discussion last week regarding the Bourne and Grant Electric Lighting Company and their scheme. A searching inquiry is to be made into an alleged "scandal" in connection with the matter. It is also suggested that the Council should take immediate steps to recover the provisional order, and a motion on this point will come up at the next meeting.

Coventry.—The first of the electric lamps which are to light the principal streets has been erected, and was lit up for the first time on Wednesday last week. There are to be 40 lamps of 2,000 C.P. each.

Cromer.—Edmundsons' Electricity Corporation proposed applying for a provisional order, but the District Council has itself resolved to make the necessary application for a municipal one.

Denny.—A company proposes applying for electric lighting powers, and the Police Commissioners will not oppose.

Dover.—The cost of electrical illumination of the sea front from the middle of July to the end of September will be £165, including a special installation of 1,000 lights.

Dumfries.—The Council will oppose a proposed application by the Edmundson Electricity Corporation, Limited, for a provisional order, it being the intention of the Gas Commission to take up the matter itself.

East Hampstead.—The Electric Works Company proposes to apply for electric lighting powers for the district.

Eccles.—At the last meeting of the Corporation it was reported that estimates for laying a cable from Clarendon Road to Moston Road, and from Victoria Road to Ellesmere Road, had been received. The cost would be about £160. In reply to questions, Alderman Kendall expressed a hope that those who required the electric light would send in their applications, and give the committee confidence in regard to extensions in the future. Their provisional order applies to the whole borough.

Edinburgh.—The result of the year's operations of the Edinburgh electric lighting from May 15th, 1897, to May 15th, 1898, have just been made up, and are eminently satisfactory. The total output has been—for private lighting and power, 2,059,763 units—an increase over the previous year of nearly 90 per cent. The total units

for public lighting has been 834,660, making a grand total of 2,894,423 Board of Trade units. The income from private lighting and power has been £30,024 4s. 2d., and from public lighting £7,993 5s., making in all £38,017 9s. 2d. The expenditure has been—For generation of electricity, distribution, management, rates and taxes, upkeep of public lamps, and all expenditure in connection with the undertaking, except interest and sinking fund, £16,744 15s. 4d.; interest and sinking fund, £13,623 6s. 7d., making a total expenditure of £30,368 1s. 11d., and leaving a net profit on the year's working of £7,649 7s. 3d. Of this sum £4,000 is to be put to reserve, leaving £3,649 7s. 3d. available as a contribution to the rates, or £1,649 7s. 3d. more than was estimated.

Edmonton and Enfield.—The subject of electric lighting has come before several of the local authorities in North Middlesex upon communications received from companies giving notice of intention to apply for powers to supply the districts with the electric light. Edmonton Council have decided not to support any proposal of the kind, but have directed inquiries to be made as to the formalities to be observed in the event of the Council seeking powers. A sub-Committee of the Enfield Council have discussed the question of making application for a provisional order to supply the district with electric light, but have not yet come to any decision on the subject.

Egham.—The Electrical Power Distribution Company proposes applying for electric lighting powers for the district.

Falmouth.—The United Electric Light and Traction Company intend to apply for a provisional order for lighting the borough.

Farnborough.—The Electric Works Company, Limited, proposes to apply for electric lighting powers for a district, including Farnborough.

Finchley.—The North London Electricity Company proposes to apply for electric lighting powers for this district.

Folkestone.—The borough surveyor is to see to the fixing of the lamp standards on the Leas, as he puts the cost at about 15s. each, whereas in an estimate sent in by Messrs. Callender's Company £2 each is quoted. The cost of electric lighting for the Baths it is considered would be too great, therefore gas is to be used.

Freshwater (I.W.).—The Yarmouth Electric Light Company proposes to apply for electric lighting powers for this district.

Glasgow.—At a meeting of the Electricity Committee of the Glasgow Corporation held on 12th inst., it was reported that the gross income, including receipts from private and public lighting for the year just ended, was £36,360, as compared with £30,474, being an increase of £5,886. These results have been obtained, notwithstanding the reduction made a year ago in the price of electricity, and after meeting the cost of production, the balance is carried to depreciation and sinking funds. Owing to the expression of a good deal of dissatisfaction at the present method of charging, the committee is considering the advisableness of making a change.

Glyncorrwg.—Mr. Lewis, of Messrs. Lewis & Fletcher, electrical engineers, Cardiff, has reported to the Council upon the proposed scheme for lighting the district. The report, together with that of Mr. Browning, of Neath, for gas, was adjourned until next meeting.

Gosport.—At the last meeting of the Gosport District Council, a letter was read from the Electrical Power Distribution Company, intimating that it is intended before December 21st next to apply to the Board of Trade for a provisional order to introduce the electric light in Gosport and district. The letter was referred to the Electric Lighting Committee.

Hackney.—The Vestry has received intimation from Mr. Sydney Morse and the Metropolitan Electric Supply Company of intentions to apply for provisional orders for the district, but, in accordance with its several resolutions, the Vestry will oppose such applications. The Board of Trade has agreed not to consider revocation of the Vestry's order for another 12 months. A cheque has been drawn for £200 to be paid into the High Court on account of the action of Medhurst *v.* Hackney Vestry, that sum being sufficient, in the opinion of counsel, to satisfy the plaintiff's claim.

Hampstead.—The Metropolitan Electric Supply Company, Limited, has given notice of its intention to apply for a provisional order for lighting the parish. As is well known, the Vestry has already an installation at work in the district, while a portion of it is served by the Hampstead Electric Battery Company. Both the Lighting and the General Purposes Committees of the Vestry have recommended that body to take every possible step to oppose the application for the order.

The Lighting Committee has reported as follows:—"That there are at present in force in Hampstead two systems of charging for electric current, viz., the discount system and the maximum demand system, and that each consumer was entitled to be charged by which system he preferred, and that it was the unanimous opinion of the Committee that the maximum demand system should be adopted throughout." The Committee, therefore, recommends: "That maximum demand indicators be fixed upon the premises of all new consumers, and that on or before January 1st, 1899, maximum demand indicators be fixed upon the premises of all consumers, and that every consumer be charged on that system as from the above-mentioned date."

Hastings.—As the Local Government Board did not give its sanction in time to the borrowing of the necessary money, the Corporation was unable to complete the purchase of the Electric Light Company's undertaking on June 30th. The matter will not now be settled up until December 31st.

Hereford.—Several tradesmen, having grown weary of waiting for an electric lighting movement on the part of the city fathers, have put in private installations of their own, with apparently very satisfactory results. It would seem that these steps and the rumours of others similar have induced the Corporation to at last decide to light the centre area of the city by electricity. The generating works, it is expected, will be situated in Widemarsh Street, and it is understood that the work of carrying out the scheme will be commenced in earnest at an early date. In the meantime there are rumours of other private installations being fitted up, gas being employed to provide the motive power. Among these, our correspondent learns, is one at the offices of the *Hereford Times*.

Heston-Isleworth.—The Electric Power Company has given the District Council notice of its intention to apply for a provisional electric lighting order. Referred to the Works Committee.

Holborn.—The Smithfield Markets Electric Supply Company, Limited, have notified the Holborn Board of Works that they intend to apply for a provisional order to supply electricity to the district.

Hornsey.—The North London Electricity Company, of Prescot, Lancashire, have written to the Hornsey District Council stating that they intend to put down a large electricity works for the supply of a number of districts in the north of London, if powers are granted, and hope to be in a position to offer electricity to the Council wholesale, at at least as low a price as they could generate it themselves. The Hornsey Council already has an electric lighting order, and will oppose the company's application.

Ilkeston.—The Town Council resolved last week to apply to the Board of Trade for a provisional order to supply electricity and to construct tramways.

After passing resolutions *re* provisional orders for lighting and tramway construction, the Council went into committee for the purpose of considering the appointment of an electrical engineer, to report as to the best method of providing an electrical energy generating station, and dealing with the question of supplying energy generally, as well as to report on the most modern system of constructing tramways.

Islington.—Mr. Robert Gordon, chairman of the Electric Lighting Committee, submitted to the Vestry on 15th inst. a report in regard to considerable extensions of the electricity works proposed to be carried out at an expenditure of £72,000. The report stated that the demand for electrical energy was increasing so rapidly that the 500 H.P. engine and dynamo now being fixed would be insufficient to do more than meet the requirements of private consumers after providing for the necessary reserve, and that a great portion of the additional street lighting already authorised would have to stand over until new plant was installed. Much inconvenience had been caused in the past by the delay in building operations, which had prevented the engineering work being carried out with necessary expedition, and the Committee had instructed the architect to draw up plans for a considerable extension. Mr. Gay, the electrical engineer, estimated that the increased boiler and engine house accommodation would be sufficient to contain the whole of the additional machinery required for about seven years, and he advised that plant to the extent of 3,000 horse-power should be placed on order forthwith, two engines and dynamos of 1,000 horse-power each to be erected within 12 months, and the third to be erected within two years. The estimated cost is as follows:—

Six boilers and fittings, complete	£8,400
Three 1,000-horse-power engines	16,500
Three 600-kilowatt alternators	15,000
Steam and exhaust pipes, pumps, heaters, injectors, switch gear, regulators, connections, and contingencies, say	9,000
	£48,900
Architect's estimate for building extensions ...	22,500
Total	£71,400

The Committee, therefore, recommended that the work should be carried out, and that a loan of £72,000 should be obtained for the purpose. After some discussion the recommendation was adopted on condition that no contracts should be entered into or liability incurred until the loan had actually been raised.

Kensington.—The Vestry last week decided to withhold consent to the applications being made by several companies for electric lighting orders, and resolved to itself apply for a provisional order.

The Vestry has accepted the offer of the House-to-House Electric Light Supply Company to erect and maintain for 12 months, free of cost, seven public arc lamps on the south side of Kensington High Street, and to supply, free of cost, energy for such lamps.

Kilmarnock.—The Corporation has been compelled to bestir itself in the matter of electric lighting, by a notice which has been served upon it by the Edmundson Electricity Corporation, Limited, on behalf of the Urban Electricity Supply Company, Limited, announcing the intention of the latter to apply for a provisional order. Some of the members of the Council were in favour of considering the propriety of the Corporation itself introducing the electric light, but ultimately it was agreed to await the advice of the Parliamentary agent of the burgh before coming to a decision in the matter.

Larne.—The Larne Light Company have taken the opportunity afforded by the cessation of street lighting during the summer months to repair all their incandescent and arc lamps. An improvement has been effected in the manner of suspending the arc lamps, curved iron brackets being now used.

Leatherhead.—The District Council's provisional order has now received the Royal assent, and it is proposed to invite tenders for it from the general public.

Lowestoft.—The Corporation have obtained a provisional order for electric lighting, and there has been quite a rush of applications to work it. The latest are from Mr. E. E. Gabriel, managing director of the East Coast Ice Manufacturing Company at Lowestoft, and from the Municipal Electricity Supply Company. The former asked to be granted a concession for lighting the borough, and the company made offers. A reply has been given that nothing definite has yet been decided.

Marylebone.—It was mentioned at the last Vestry meeting that the authority had obtained in the Bill promoted by the Metropolitan Electric Supply Company, the insertion of a clause providing for the protection of the parish consequent upon the passing of the preamble of the Bill to authorise the erection of a generating station at Willesden to supply the metropolitan area. It was stated that there was nothing in the Bill that released the company from its obligations under the agreement made with the Vestry in 1889, and that the company would be bound to maintain, as now, the generating stations in Rathbone Place and South Street, Manchester Square.

Mexborough.—The clerk of the District Council is to obtain information *re* electric lighting from other towns for the guidance of the Electric Lighting Committee.

Monmouth.—Messrs. Siemens have been instructed to proceed with the laying of the cable instead of waiting for the construction of the rising main to Osbaston, the extra cost of the firm making their own trench being about 1s. 3d. per yard, which would amount to about £100.

The Monmouth Police Station is to be lighted electrically.

Morecambe.—The minutes presented at the last meeting of the Urban District Council showed that the Electric Light Committee have been very busy recently. Mr. Parkinson, the engineer, in submitting reports of his tests of a steam dynamo taken after erection said that the insulation was only 2·4 megohms instead of 50, and he could not advise the Council to accept the armature, but call upon the contractor, Mr. Parker, to rectify it. The other steam dynamos have been tested before leaving the works at Colchester, as well as No. 2 exciter. It is expected that the transformers will be completed at an early date. Plans have been passed for a weighbridge house and a testing room. The girders have been ordered from the Phœnix Foundry, Lancaster; Messrs. J. Nicholl & Sons have the contract for the weighbridge house, &c. Insurance will be effected on the plant and premises to the following extent:—On buildings, £2,000; machinery and plant, £2,000; on dynamos and armature therein, £1,250; total, £5,250. The office selected is the Fine Art and General Fire Insurance Company, Limited. One mile of service cable has been purchased from Messrs. Callender.

Musselburgh.—An electric power syndicate has given notice to the Town Council of intention to apply for a provisional order.

Newington.—The Electric Lighting Committee in a report presented to the Vestry on Wednesday evening, recommended that the work of removal and relaying of pavements, and excavation of trenches in connection with the laying of the electric light mains, should be undertaken by direct labour under the supervision of the surveyor. This was agreed to.

Newmarket.—The plans for generating station for the Newmarket Electric Lighting Company are before the Council for consideration.

Newport (I.O.W.).—The Ventnor Electric Light and Power Company proposes applying for a provisional order for Newport.

Newton Abbott.—Edmundsons' Electricity Corporation has notified the Parish Council, on behalf of the Urban Electricity Supply Company of its intention to apply for electric lighting powers.

North Berwick.—The Town Council recently had before it a report prepared by Messrs. Burstall & Monkhouse on the question of electric lighting. The capital cost for an installation to supply 2,500 lamps was estimated at £7,600. The Council, after discussion, decided to write again to the firm, and ask for some supplementary details, and a special meeting will be called at an early date to decide what steps shall be taken in the matter.

Newport.—At a recent meeting of the Electricity Committee of the Newport (Mon.) Corporation, a return showing the financial result in respect of the third year's working up to March 31st, 1898, was submitted, of which the following is a summary:—

Year.	Gross profit after payment of working expenses.	Interest on loans.	Sinking fund.	Deficiency after payment of interest and sinking fund.
Third year ending March 31st, 1898	£1,716	£1,362	£788	£434
Second year ...	866	1,060	768	962
First year ...	224	927	707	1,410

The office manager, during the past month, has obtained orders for 420 lights. The number of lights now connected and on order is equivalent to 18,600 8-C.P. lamps. About 50 lights would be required in Watchhouse Parade, but the mains do not extend so far, and a canvass is to be made of that district, with a view to the committee considering the question of extending the mains. A report by the consulting engineer upon the progress of the buildings and machinery in connection with the extensions was read. He asked for instructions with regard to the ordering of the arc lamp transformers required for the extension of the arc lighting, and it was resolved that this matter be left to the sub-committee.

At a meeting of the Electricity Sub-committee, it was resolved to instruct the consulting engineer to report upon the various arc lamps which have been tested, and also submit a scheme for the arc lighting and fixing of transformers on Newport Bridge. As the bulk of the plant would not be delivered until probably about January, March 25th, 1899, is the probable date for the commencement of the new arc lamp lighting. In regard to the question of smoke nuisance, Mr. Hammond has been authorised to order a set of apparatus as used at *Tit-Bits* offices, manufactured by the Improved Regenerative Furnace Syndicate, Limited, for £80, and a Newton's smoke destructor, such as he had seen at work in Dublin, for £55. This price is to be paid only in the event of the apparatus being successful; if either be unsuccessful, it is to be taken up and removed without cost to the Corporation.

Paisley.—The Town's Free Library and Museum of this town are to be lighted by electricity, the Council having accepted the tender of Messrs. Jas. Kilpatrick & Son, electrical engineers, Terrace Buildings, Paisley.

Partick.—The Kelvinside Electricity Company proposes to apply for a provisional order, but the Commissioners, who are trying to arrange with the Glasgow Corporation for a supply of current to Partick, will oppose.

Pemberton.—The Pemberton District Council have in view the adoption of electric lighting in their district, and desire to receive for consideration suitable schemes for carrying out the work. These schemes must be sent to Mr. Paul Partington, clerk to the Council, before August 14th. Pemberton is a flourishing township, close to Wigan, so close, that an attempt was made a few years ago to include it in a scheme for a greater Wigan. The population in 1891 was 18,400. The gas now used is supplied from the Wigan gasworks. The District Council will give £50 for the best scheme submitted.

Penistone.—The Board of Guardians last week considered an estimate obtained from Messrs. Dixon, Clayton & Co., Penistone, of the cost of putting down an electric installation. Considerable discussion took place, but it was resolved to leave the matter in the hands of a committee.

Penzance.—Edmundsons' Electricity Corporation has given notice on behalf of the Urban Electric Supply Company, Limited, that it intends applying for a provisional order for Penzance.

Perth.—The Police Commission has resolved to ask the member of Parliament for the city, and the two county members to oppose the granting of the General Power Distributing Company's Bill, in order to prevent the possibility of competition once a municipal plant has been put down at Perth.

Plymouth.—At a recent Council meeting Mr. Debnam said that the Electric Light Committee were doing their best to push the work forward at the electricity station. If the buildings could be completed there was no doubt that the electric light would be installed and working during the coming winter.

Portsmouth.—The Electric Lighting Committee, at a meeting held on Wednesday, decided to recommend the Town Council to adopt the free wiring system in connection with electric lighting.

Radcliffe.—A consulting electrical engineer has reported to the Council that the cost of electric lighting works in Radcliffe would be £16,000, the annual revenue £3,037, annual expenditure £2,389, profit £648 10s.

Ramsgate.—The Town Council will strenuously oppose all applications to be made by companies for electric lighting provisional orders.

Ryde.—At a meeting of the Town Council last week a discussion took place on a proposal to appoint a committee "to consider the subject of the introduction of electricity into the town of Ryde, with power to employ a consulting engineer to advise fully on the subject, and to bring up a report at an early date." It was urged that as it had been decided to light the town by electricity, it was the duty of the Corporation to ascertain the best means of doing it. An amendment was moved to adjourn the matter until the next meeting, in order that the ratepayers might be consulted. The amendment was lost, five voting for it, and 10, including the Mayor, against. A committee was then appointed.

Rhyl.—At last week's meeting of the Urban District Council the General Purposes Committee reported having considered Mr. Buddicomb's proposal to introduce electric light and electric tramways into Rhyl, and after discussion it was resolved to ask Mr. Buddicomb to submit a more detailed scheme for the consideration of the Council. The Town Clerk said he had received several notices of intention to apply to the Board of Trade for provisional orders to supply Rhyl with electric light. One was from the solicitors representing Mr. Buddicomb, and another from "The Rhyl Electricity Company," who, on inquiry being made, turned out to be the British Insulated Wire Company, Limited, whose offices are at Prescot. The other applicants were the United Electric and Traction Company. The consideration of the several applications was deferred, pending the receipt of Mr. Buddicomb's detailed scheme.

St. Albans.—The Corporation has applied to the Board of Trade for a provisional order. It is the intention of the Corporation, when the order is granted, to lease it to a private company, with reservations for purchase within a certain period. The lighting arrangements of St. Albans, though they are as good as incandescent lights can make them, are capable of improvement. The Corporation, however, has so much in hand—the sewage works are causing considerable trouble—that it is unlikely that the electric lighting will be hurried on.

St. Helens.—The following minutes of the Electric Lighting and Traction Committee were recently confirmed by the Council. A meeting of this Committee was held on June 22nd, Councillor Dixon-Nuttall in the chair. Read the minutes of a meeting of the sub-committee on 7th June, the Mayor in the chair. Referring to resolution No. 1, passed at the meeting of the Electric Lighting and Traction Committee, held on May 25th last, with reference to the question of the substitution of engines of a greater horse-power than those stated in the contract, &c. Dr. Hopkinson attended the meeting, and the resident electrical engineer submitted a report dealing with the matter, and also with respect to the proposed removal of the electric lighting station from Warrington Road to Boundary Road. The sub-committee, together with Dr. Hopkinson and the resident electrical engineer, having fully discussed the matter, resolved that it be a recommendation to the Electric Lighting and Traction Committee to lay out the Boundary Road site, so as to concentrate the whole of the plant, both for lighting and traction purposes there. Resolved also (1) that four Willans engines, together with Mather & Platt dynamos, of a capacity of, as to two thereof, from 100 to 150 horse-power, and as to the remaining two thereof, 250 to 300 horse-power be purchased; (2) that the condenser be increased, so as to provide for 400 instead of 200 horse-power, the makers thereof to be settled by Dr. Hopkinson; and (3) that space having been provided for the increase of boiler power, the question of such an increase be left over for the present. It was resolved, in view of the possible lighting of Church Street, Bridge Street, Liverpool Road, Croppers Hill, Westfield Street, Cotham Street, Corporation Street, Duke Street, and Shaw Street, by means of arc lamps, that finials be put on every second or third trolley pole in such streets; and that, at the same time as the mains ordered to be laid at the last meeting of the Committee, are laid, there be also laid along the route thereof a service cable for each lamp.

St. Pancras.—On Wednesday, on the motion of Dr. W. Smith, the Vestry approved the action of the Electricity and Public Lighting Committee in giving instructions for the whole of the arc lamps in the parish to be kept alight during the night in order to meet the complaints, especially as regarded Gray's Inn Road, respecting the alternate extinction of the arc lamps at midnight. On the recommendation of the Committee, it was resolved to oppose the application of the Metropolitan Electric Supply Company for a provisional order for St. Pancras. The Electricity Committee further reported that negotiations had been concluded with the North Metropolitan Railway and Canal Company for the purpose of utilising the Canal water for condensing purposes at the King's Road station. The agreement provided for the payment of £150 per annum up to 1,000 horse-power, and 1s. per annum for every additional horse-power beyond the 1,000 H.P. The Committee recommended, and the Vestry decided to approve the recommendation. The Committee announced, for the information of the Vestry, that the extension along Prince of Wales Road to Maldon Road and Queen's Crescent was now being proceeded with, and that the Highgate extension would be commenced in the course of a few weeks.

Shoreditch.—At the Vestry meeting on Tuesday tenders were opened for the supply of boilers and transformers in connection with the projected extensions of the electric supply station. In reference to these tenders, Mr. H. E. Kershaw, chairman of the Lighting Committee, asked and obtained permission to move as a matter of emergency, in view of the summer vacation, that the Vestry should give power to the Committee to deal with and accept tenders as advised by the engineers, if practicable. He stated that the importance of the question was very evident, since a delay of six weeks would throw the work so far back that it would be impossible to get the extension completed in time for the winter. The tenders, which were for the supply of boilers and transformers, had been hurried forward with all speed, but it had not been possible to get them before the Vestry until that evening. If the Vestry empowered the Lighting Committee to act in the matter, their proceedings would be fully reported to the Vestry. Having been seconded, the motion was unanimously adopted. On the ground of urgency the Committee were also authorised to have specifications prepared and to invite and accept tenders for the extension of the boiler house and battery room. The Town Hall Committee reported for the information of the Vestry that they had given instructions for three Brockie-Pell lamps and brackets to be fixed outside the entrances of the Town Hall.

Smethwick.—The Council's Electric Lighting Order has been granted. The Midland Electric Corporation for Power Distribution, Limited, has given notice of intention to apply again in the next session of Parliament for an order to enable them to supply electricity in the Smethwick district.

Southampton.—Last week the Council had a lengthy debate regarding the electrical engineer's salary. Mr. Lee was receiving £180 per annum, and the Committee proposed an immediate advance to £250 in view of the heavy and important work devolving upon him. After many amendments it was agreed to raise the salary immediately to £210 only, and to give annual advances of £20 up to £250. The whole matter looks like being re-opened at the next meeting by those who consider, as we ourselves have long been convinced, that Mr. Lee's services are well worth £250.

Southgate.—The North London Electricity Company and the Tottenham and Edmonton Gas Company propose to apply for electric lighting powers for the district.

Stroud.—Messrs. Williamson & Co., Limited, wholesale manufacturing clothiers, of this town, have just decided to erect an additional factory, and to use electricity both for lighting and power. The architect is Mr. V. A. Lawson, of Stroud.

Sunderland.—On 13th inst. a Local Government Board inquiry was held *re* the Council's application to borrow £26,000 for electric lighting purposes. The Town Clerk gave particulars of the sums already expended in excess of the loans for which, as well as for further extensions, the money was required. Of the sum proposed to be borrowed, the money already spent included £638 for high tension plant and £1,487 for the mains, which was for extra work actually done. They now proposed to expend £12,550 on the extension of the buildings, new boilers, new steam transformers, extending the switchboard, &c. Upon the extension of the mains a sum of £11,147 would be spent. Mr. Snell said that everything had been sanctioned by the Board of Trade, except to double the pressure of the supply. They now worked the town on the alternating current system at 110 volts, and this they proposed (taking advantage of the Board of Trade new regulations) to change by substituting a direct current at 220-volts. The primary cables would still be usable, only two high tension cables would be removed, and these would be brought into requisition elsewhere subsequently. The new engines included two high speed compound three-crank direct coupled to 440-volt dynamos. The £11,000 for the mains included the extension of the feeders, the mains to the workhouse, or extension of the mains and services, and the cost of the changes in the system. The Town Clerk said, as to the financial result, the first year's cost was £2,808 6s. 11d., the revenue £2,165, leaving a deficiency of £642 12s. 2d.; the next year the cost was £3,696 13s. 6d., the revenue £2,714 7s. 10d., leaving a deficiency of £982 5s. 2d., which was chiefly due to a reduction of the price to consumers by ¼th. In 1897-98 the cost was £4,833 18s. 3d., and the revenue £4,251 6s. 2d., a deficiency of £582 12s. 1d. For this year the estimated cost was £6,070, and the revenue £6,234, leaving a net profit of £164. The actual result for the first quarter of this year had been ascertained, and showed a decrease on the expenditure and an increase on the estimated receipts. They had turned the corner.

Surbiton.—The District Council has replied to applicants that it cannot entertain proposals to take over its electric lighting powers.

Swinton and Pendlebury.—At the ordinary meeting of the District Council held on Monday last week, the minutes of the General Purposes Committee, which had been approved, stated that Messrs. Jas. Berry, R. Berry, Bold, Buck, Gerrard, Hampson, and Rawlinson, had been appointed a special committee to obtain information respecting the best system of domestic and public lighting, and supply of power by electricity. They will also report to the Committee whether it is desirable that a provisional order to supply the district with electricity should be applied for in the next session of Parliament.

Teddington and Twickenham.—It will be remembered that the District Councils of these two places have been conferring on the electric lighting question, and a joint committee meeting was held to consider proposals of Edmundsons' Electricity Corporation. The General Purposes Committee reports that a letter has been received from Edmundsons' Company, giving notice on behalf of the Twickenham and Teddington Electric Supply Company, of intention

to apply for a provisional order. A similar letter was received from the Electrical and General Engineering Company, of 17, Gracechurch Street, but the two Councils are advised by the committee to oppose both applications. Mr. Warden Stevens and Messrs. Wardrop and Whittaker have offered their services to the Councils as consulting engineers, and their communications have been acknowledged.

Wales and the Border.—During the last few weeks municipal activity in the direction of electric lighting has become very pronounced in the southern counties of Wales and the border counties.—At Mardy, in the Rhondda Valley, notice has been given by the Electric Lighting Company that they intend to take steps again for obtaining a provisional order to supply the district with electricity.—At Hereford a committee has been authorised to open negotiations for the purchase of a site for electricity works.—At Ludlow the Corporation has agreed to apply for a provisional order to supply electricity for public and private purposes out of the borough.—At Monmouth Town Council the question was asked when it was expected the electric lighting would be installed, as the necessary tentative steps had been taken. The Town Clerk rejoined that the work had at last been commenced.—The Towyn Urban District Council (Merionethshire), have again been discussing the matter of electric lighting, and it appears that the scheme for lighting both this delightful watering place and that of Aberdovey, where the famous Jesuit College was lit by electricity, is to be carried out at a cost of £6,000. This will leave a margin for contingencies. The present lighting of the district is said to be far from satisfactory.—At Glyntowy, Mid-Glamorgan, Messrs. Lewis & Fletcher, engineers, Cardiff, have reported upon a scheme suggested for lighting that district. The consideration has been adjourned.—At Pembroke Dock the United Electric Light and Traction Company have sent the local Town Council statutory notice that they intend to apply for a provisional order. The matter has been referred to the Ward Committees.

Walsall.—The Electric Lighting Committee reports that the total number of consumers supplied on June 30th last was 105. The total units generated at the station during the month of June was 8,118.

West Ham.—In a report to the Council, the Highways and Parks Committee, deal with various matters connected with the electric lighting undertaking. They say that the electrical engineer, having reported that Messrs. Rogers had declined to accept the order for wiring the pumping station and electric light station at the schedule of prices in their contract for wiring the other public buildings, they had directed him to obtain estimates from several of the other firms who tendered for the previous contract. The electrical engineer had reported that a satisfactory understanding had now been arrived at with Messrs. Drake & Gorham, the contractors for the arc lamps, with whom the Town Clerk had been in correspondence, as to the carrying out of the contract. The Committee also reported that, having had under consideration a letter from Messrs. Rogers & Co., complaining of the difficulties they had experienced in carrying out their contract for wiring the public buildings and offices, and asking for some allowance and an extension of time, they had left the matter in the hands of the electrical engineer to deal with.

Weston-super-Mare.—The District Council has informed a company which proposed applying for electric lighting powers that it is proceeding with its own scheme.

Weybridge.—The representatives of the Walton and Weybridge Councils will confer upon the matter of electric lighting.

Whitehaven.—Messrs. Siemens have asked, through Dr. Hopkinson, for their final certificate for payment of balance of their account. As they are bound to maintain the renewed cables until September next year, it was stated at the last Council meeting that the Water and Light Committee thought the retention money should not be paid until that period of maintenance was expired. The point is being looked into by the Town Clerk.

Whitstable.—The Whitstable Electric Light and Power Company have notified the Urban District Council of their intention to apply for powers to supply electricity within the district. Mr. Mann, a director of the company, attended a meeting of the Urban Council on Thursday last week, and explained the scheme. He said the principal cable would go down High Street to Tankerton, and as the demand for customers arose, it would be extended further. The Council adjourned the consideration of the matter for a special meeting, to be held on the 28th inst.

Willesden.—The Metropolitan Electric Supply Company were last week stated to have given notice of intended application for a provisional order for the Willesden district. The District Council has already obtained an order for itself.

Windlesham.—Mr. A. M. Kennett, of Camberley (solicitor to the Electric Works Company, Limited), has given notice of the intention of the company to apply for a provisional order for electric lighting over the parish of Windlesham. The engineer to the company is to be invited to a special meeting of the Council.

Withington.—The Manchester Corporation has informed the District Council that they would be unable to supply the Withington district with electricity for lighting purposes until midsummer next year.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bradford.—At a meeting of the City Council on July 12th the Tramways Committee were instructed to at once take into consideration a comprehensive scheme of tramway extension in various parts of the city with the view of applying for the necessary provisional orders next November. There are at present over 20 miles of tramways in Bradford worked by steam. The lines belong to the Corporation, and are let to the Bradford Tramways and Omnibus Company, Limited, and to the Bradford and Shelf Tramway Company, Limited. The former company usually pay 10 per cent. dividend, and occasionally 8 per cent.; the latter have almost uniformly paid 8 per cent. The Corporation are just completing the construction of two new lines, one to Great Horton, two miles in length, and one to Eccleshill, nearly three miles in length. These will be worked by the Corporation themselves, and the motive power will be electricity. The leases of the companies who hire the other lines run out in 4½ years, and it is the intention of the Corporation then to take over these and work them also by electricity. Amongst the lines which will, in all probability, be included in the comprehensive scheme to be brought forward by the Tramways Committee will be extensions of the Great Horton line to Queensbury, and of the Allerton line to Thornton, and new lines between Undercliffe and Bradford Moor and West Bowling, and another line to Allerton from Manningham.

Brompton and Piccadilly Electric Railway.—It is stated that sufficient shares were taken up of the recent issue to justify the directors in going to allotment.

Cheltenham.—A special committee of the Cheltenham Town Council have almost unanimously agreed on a scheme for the construction of an electric tramway to the summit of Cleeve Hill. The committee, accompanied by the Town Clerk and the Borough Surveyor, have visited Kidderminster and were greatly pleased with the electric overhead trolley tramway there. The following route is the one the majority of the committee favour:—From the Midland station along the Gloucester Road to the Cattle Market, through the bye streets running parallel with the Lower High Street to St. James's Square, and thence *viâ* Clarence Street, North Street, Portland Street, and Prestbury Road to Prestbury and Bishop's Cleeve.

Chiswick.—The clerk last week reported to the District Council having submitted the agreement between the Council and the London United Tramways, Limited, which it was proposed to annex to the Bill, to the chairman of the Parliamentary Committee. He objected to the clause providing that if any better system of traction than the overhead trolley wires was adopted in five large towns and paid 5 per cent. profit it should be also adopted on the lines of the London United Tramways. Mr. Cook thought this was a most important matter, as the clause which was inserted in the agreement between the Tramway Company and the Council seemed in danger of being invalidated. Mr. Bilton agreed that it was one of the most important parts of the agreement. The clerk replied that it was practically inoperative owing to the condition with regard to 5 per cent. The matter was left in the hands of the clerk to do the best he could for the Council.

Dublin.—On 12th inst. the electric cars to Dalkey were started from the O'Connell Bridge end of D'Olier Street, and this will be the city terminus till the main drainage works at Burgh Quay are finished. Nelson's pillar will then be the station.

Dudley.—Last week at the Board of Trade offices, Whitehall, Sir T. Courtenay Boyle, secretary to that Board, who was accompanied by Mr. Hopwood, C.B. (secretary of the Railway Department), Sir Francis Marindin, Sir Thomas Blomefield, Mr. A. T. Thring, and Mr. H. A. Steward (secretary to the Light Railway Commissioners), held an inquiry in regard to the objections raised by the Dudley Town Council to the confirmation of the order made by the Light Railway Commissioners authorising the construction of certain lines by the British Electric Traction Company. Mr. Freeman, Q.C., opened the case on behalf of the Corporation of Dudley. Mr. Morse replied for the company, and Sir Courtenay Boyle, interposing, said a written suggestion of a possible arrangement had been handed to him, and he thought the suggestion was one that should be considered by both sides. Representatives of the Corporation and the company held a private consultation for a few minutes, and then invited Sir Courtenay Boyle to join them. After some conversation in his presence they returned, and Mr. Freeman announced that, on behalf of the Corporation of Dudley, he consented to the order being confirmed, adding that certain terms would be agreed between Mr. Morse and himself respecting some minor points, with which he would not trouble the officials of the Board of Trade. The clauses of the order were then gone through, and some questions of detail decided. The Board of Trade insisted upon the insertion of a clause stipulating that no tramway rail shall be laid within 9 feet 6 inches of the kerb, unless with the sanction of the Department, and Sir Courtenay Boyle suspended decision in regard to clauses in which the usual wording of provisions as to opening roads and disturbing gas and water mains had been varied by the Commissioners. The basis of the compromise was that the company shall construct and work the tramways, and that the Corporation shall have power to purchase the undertaking after a certain period upon terms to be embodied in an agreement.

A Birmingham paper says that as a result of the arrangement which was come to at the Board of Trade offices no time will be lost in expediting the conversion of the Stourbridge and Dudley tramway for working by electric power.

Electric Traction in Italy.—The Societa Mediterranea has applied for the approval of the Government to the tests it is about to carry out with accumulator traction on its railway between Milan and Monza.

Hyde.—The electric tramway between Oldham and Hyde, *viâ* Ashton-under-Lyne and Denton, is stated by a Manchester paper to be approaching completion, and the Council had received a letter from the British Electric Traction Company offering £500 towards proposed alterations in Stockport Road at the "Ring of Bells" corner, subject to the sanction of the Board of Trade being obtained to the necessary deviation; and the company were also prepared to widen the river bridge between Hyde and Denton. A committee was appointed to interview representatives of the committee and owner of property, also the county authorities, on the subject.

Leeds.—Last week the Highways Committee resolved upon a further important extension of the Corporation tramways. It is proposed to carry a branch from the Meanwood Road section along Cambridge Road, Woodhouse Street, Hyde Park Corner, and Victoria Road to Cardigan Lane, whilst a branch from the Wortley section is to be continued from Wellington Road, along Armley Road to Branch Street, Armley.

Limerick.—Last Friday, by instructions from the Commissioners of Public Works, Mr. Alfred D. Price, C.E., held an inquiry at the Royal Hotel concerning the merits of the proposed tramways scheme from an engineering point of view.

The London County Council and the Tramways.—In a report which has just been published, says the *Times*, the Highways Committee of the London County Council state that, in view of the probable development of the Council's policy as regards the working of the tramways which it may in the future acquire, they are of opinion that it is expedient that a tramways department of the Council should be established for the purpose of dealing with all matters relative to tramways acquired or to be acquired by the Council. They point out that there is no doubt that in the near future many important questions will arise as regards the management of tramways when acquired, the systems of traction to be adopted in preference to the present system of horse traction, and many other matters connected with the working of tramways, all of which would have to be dealt with. The committee further state that, in accordance with the resolution of the Council, they were endeavouring to arrange for the transfer to the Council by agreement on January 1st next of the whole of the system of the London Tramways Company beyond the 2¾ miles already purchased by the Council. They accordingly make a definite recommendation for the establishment of a department for the administration of the Council's tramways. They propose to confer with the General Purposes Committee and report upon the organisation of the department.

Manchester.—On 15th inst. the Special Tramways Committee of the Manchester Corporation resolved to pay a visit to Liverpool in order to inspect 12 samples of electric tram cars. The cars are stated to have been obtained at Liverpool for the purpose of being tried.

Middlesbrough.—The Middlesbrough, Thornaby and Stockton electric tramway system was last week inspected by Major Sir F. Marindin and Major Cardew on behalf of the Board of Trade. In company with members of the local authorities, through whose area the system passes, they went over 6½ miles of line. The lines were formally opened to the public on Saturday morning.

North London.—The Light Railway Commissioners had before them on 13th inst. the application of the Metropolitan Tramways and Omnibus Company, Limited, for powers to construct electric tramways or light railways from Wood Green to Enfield and Edmonton, and from Wood Green to Tottenham. Owing to the uncompromising attitude of the opponents (which included the L.C.C. and several local authorities) the promoters withdrew the scheme.

Ramsey.—The inspection of the Ramsey and Laxey tramway was to be made on Monday. The completion of the line has been a little delayed by the construction of large stone arches at Laxey. The line is expected to be immediately opened for traffic.

Renfrew.—In regard to the proposed lines between Johnstone, Paisley, and Renfrew, the British Electric Traction Company recently wrote asking for representatives from the Renfrew Council to join the deputation from the said towns to visit Hamburg in August for the inspection of the electric trams there. The letter was laid on the table.

Rochester.—At the meeting of the Rochester Town Council last week, Mr. A. R. Norman, solicitor (of the firm of Messrs. Norman & Stigan) Chatham, attended before the Council on behalf of Mr. Jasper, who is at the head of a large electric light works at New Brompton, and laid before the Committee a proposal and a plan for carrying a line of light railways from the bottom of Star Hill, High Street, through Ironmonger Lane, and along the Rochester Common and over the bridge across the River Medway into Strood. The net cost of the purchase of the necessary property would be £23,000, towards which the company were prepared to pay £8,000, leaving £15,000, to be borne by the Corporation of Rochester. After a discussion it was resolved that the Town Clerk write informing Mr. Norman that the Corporation cannot entertain the proposal.

South Staffordshire.—During the past few days the question of municipalisation of the tramways in South Staffordshire has made a decided advance. With the exception of one, all the local authorities through whose districts the lines run, have practically decided upon a uniform course of action. The exception referred to is the Handsworth District Council, which has not yet agreed to a definite policy. It may be remembered that at the last meeting of the West Bromwich Town Council, the question of purchasing, or otherwise, the lines within the borough was referred to the General Purposes Committee. That committee met on Friday evening, when a resolution was passed unanimously to the effect that the Corporation should purchase the portion of the tramways within West Bromwich at the expiration of the present order held by the Staffordshire Tramway Company four years hence, and it was further resolved to recommend the Town Council to take steps to carry out the scheme. A conference of delegates representing the Tipton, Wednesbury, Darlaston, and Walsall governing bodies has also been held, and at this it was decided that it was advisable for the local authorities in the places through which the Staffordshire tramways pass to purchase that portion of the lines in their respective districts. The whole of the authorities interested therefore, excepting Handsworth, now present a united front with regard to the municipalisation proposal; and they will oppose the British Electric Company should they prosecute a Bill in Parliament to take over the South Staffordshire tramways. The promoters of the municipalisation policy now consider the prospect of carrying their scheme to a successful conclusion most promising. At any rate the governing bodies if they do not work the lines themselves appear to be determined to secure full control of the roads now traversed by the tramways.

The British Electric Traction Company are distributing a pamphlet among councillors and others in the South Staffordshire district entitled "Is the Municipalisation of Tramways in South Staffordshire the right Policy?" The arguments against municipalisation of tramways particularly, as affecting the company's South Staffordshire scheme and similar proposals having for their object the connection of several towns or districts by a tramway system, are set forth with considerable force.

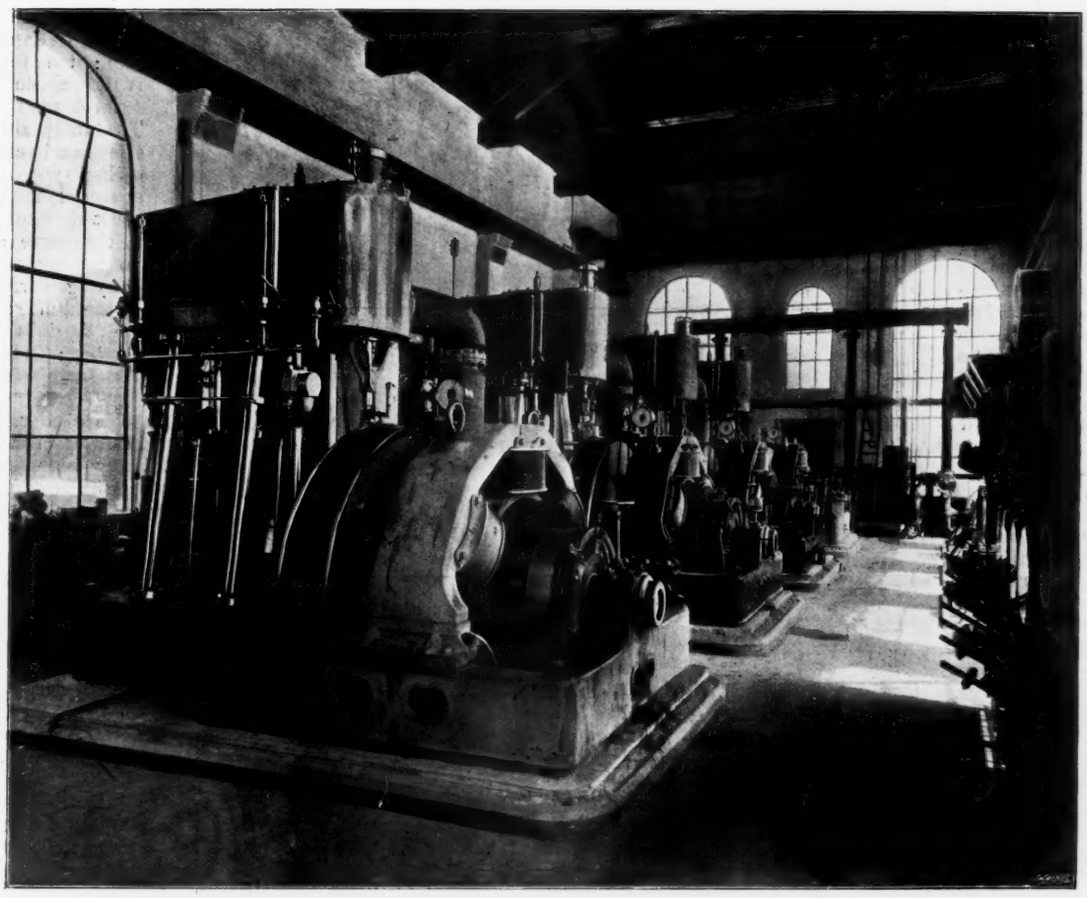
Wolverhampton.—A Special Committee of the Wolverhampton Town Council appointed in 1896 have been considering (1) the desirability or otherwise of purchasing the Wolverhampton tramways; (2) if purchased by the Corporation, whether the lines should be leased to a company or worked by the Corporation; and (3) the mode of traction which should be adopted. After a very full and patient investigation of the whole question, the Committee have decided to recommend the Council to purchase the lines; they have also agreed that the mode of traction which should be used is the electric overhead system; but the question as to whether the tramways when purchased should be leased to a company or operated by the Corporation themselves has not yet been decided by the Committee. In reviewing the history of the tramways, the Committee state that the aggregate length of lines within the borough is 4¾ miles as against 9¾ miles in respect of the whole undertaking. The system extends into the outlying districts of Willenhall and Bilston. The capital account stands at £85,189, the original cost being £5,900 per mile. The earnings of the company were equal to 1s. 2d. per mile run in 1896; but the dividends receivable by the shareholders have never been more than 5 per cent., the average being 3 per cent. The reserve fund stands at £7,407. In the year 1895 and 1896 the number of passengers carried was 3,134,871; miles run, 427,377; traffic receipts, £23,845; and working expenses, £15,399. The report states that there is no public source from which information can be obtained, showing the receipts and expenses separately in regard to the traffic within the borough; but it is estimated that the receipts from the traffic from Wolverhampton to Newbridge are much in excess of those earned on other portions of the line. The committee are of opinion that by providing a network of tramways within the borough, with an improved and quick service and reduced fares, the traffic receipts would be greatly augmented. They state that on the assumption of the Corporation becoming the owners of the tramways, the British Electric Traction Company have made an offer to take the lines on lease and reconstruct them, to pay a rental of £50 per mile, and a sum equal to 5 per cent. on the capital outlay by the Corporation, and to take the electric current from the Corporation at a given rate, viz.: for a minimum quantity of 300,000 units per annum, the sum of £2,500 per annum, and for any units in excess of such number at the rate of 1d. per unit. Other terms include specified extensions of the lines to Tettenhall, Bushbury, Heathtown, and Pennfields, and the construction of specified connecting lines in the town. On this offer the committee make no comment or recommendation. All that the committee do recommend is the purchase of that portion of the tramway undertaking as lies within the area of the municipal borough; and the adoption of the electric overhead system of traction. This report was, at the meeting of the Town Council on Monday, formally received and ordered to be entered on the minutes, and it will be fully discussed at the next Council meeting. Mr. Kendrick, from the office of the Town Clerk, is now visiting the various towns in which the tramways have been municipalised. He is making inquiries as to the success, or otherwise, of the undertakings, and will report the result of his inquiries to the special Tramways Committee.

(*Continued on page* 127.)

THE BLACKPOOL AND FLEETWOOD ELECTRIC TRAMWAYS.

Although by courtesy called a tramway, the electric line connecting Blackpool to the ancient town of Fleetwood is, to all intents and purposes, a railway in the sense of being enclosed for the greater part of the way. The line starts from the end of the promenade of Fleetwood, passes through the main streets of the town, and on the outskirts enters upon an enclosed way. It skirts the main road as far as Rossall, leaving the famous school on the right, and then branches across country till it strikes Cleveley's village. It then crosses the road which leads to Norbrick and Little Bispham, and, after passing close to the village of Bispham, it enters Blackpool, passing on the way the well-known Uncle Tom's Cabin. Upon reaching the town of Blackpool the line then becomes a mere street railway, and follows the course of the principal streets, finishing at the entrance to the Talbot Road station of the Lancashire and Yorkshire Railway Company. It is not only the enclosed nature of the road which gives the characteristics of a railway to the system, but between the towns there are fixed stopping places, and eventually there will be waiting rooms erected for the accommodation of passengers.

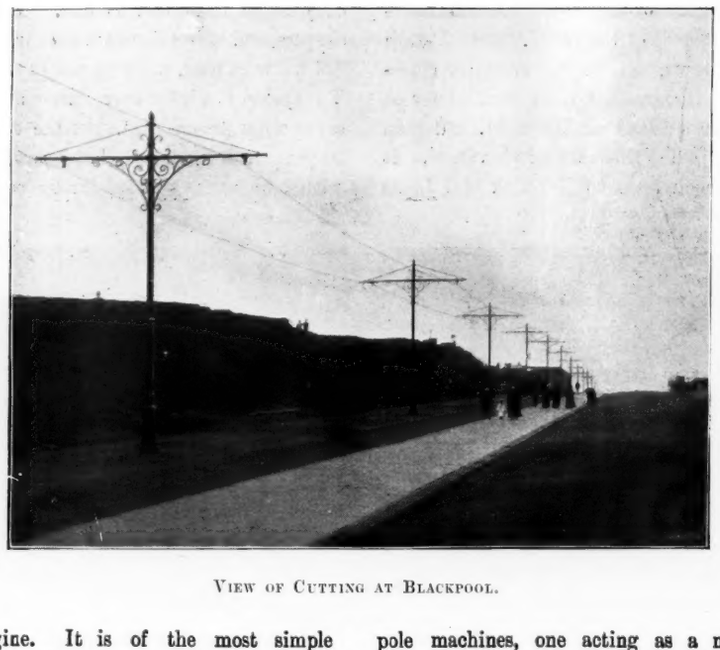
It will be seen from some of the illustrations that the line bears a very close resemblance to many of the branch electric railways that are so common in America. There is nothing picturesque about the country traversed by this line. It is mostly flat and uninteresting—a mere wind-swept bit of coast line, with a few trees bending towards the east, indicating the strength of the winds that are frequent in this part of the country. It is hardly necessary to say that apart from laying the rails in the streets of Blackpool and Fleetwood, the line has been practically made from end to end. The rails are laid upon sleepers, and it is a double track throughout. A fairly light rail has been used, probably not exceeding 66 lbs. per yard. The system is a little over nine miles in length, and of this seven miles are enclosed. In the streets of Blackpool side suspension is employed, but apart from this centre poles with double arms are used throughout. Near the Fleetwood end of the line extensive car sheds have been erected, and will house a good number of cars. At this point is also located an accumulator sub-station, to which we shall subsequently refer. The generating station is situate about three miles from Blackpool, while at the point where the line enters into the town of Blackpool a second accumulator station has been erected. Inside and out the appearance of the power house is more indicative of large plant than is usually found in English tramway systems. As a matter of fact, the total H.P. is over 1,000, which suggests that the system will need a considerable number of H.P. to keep it in effective operation.



Power House Interior.

The illustrations of the power house interior will give an idea of the size of the units employed. Considering the subject in due order, however, it may be mentioned that the

steam-raising plant consists of three Lancashire boilers, 30 feet × 8 feet, working at a pressure of 120 lbs.; in conjunction with these are two sets of Green's economisers, each possessing 96 tubes. Worthington feed-pumps are employed, and Ledward ejector condensers. For the purpose of circulating the water through the condensers, Mather and Reynold's pumps are employed. The practice of the lighting station has not been materially departed from in the arrangement of steam pipes, for they are in the form of a ring main, but it has this special feature, that the whole of the steam pipes are carried beneath the floor. The exhaust pipes are also placed in the same position. It is interesting to mention after the recent experience in electric lighting stations that a steam separator is placed not only on the main steam pipe from the boiler but one is provided for each engine. It is of the most simple description, and its arrangement will be easily understood; the steam merely enters into the outer chamber and passes upwards through the inner one, the water collecting at the bottom of this container. To readily indicate the amount of water that is collecting here, a water gauge is provided, and the assistant may then operate a valve through which the water may be blown, although usually running condensing valves are provided which enable the engine to exhaust direct to the atmosphere if necessary. A reservoir is provided, from which circulating water is drawn; the water, after leaving the engine room, runs down wooden troughing some distance round the reservoir before it passes in again. There are arranged at the present time fours set of machines. The engines are of the vertical compound condensing type, having cylinders 12 × 24 × 16, each set will indicate 200 H.P. at 180 revolutions. They are provided with an extending bedplate which carries the multipolar machine, to which we shall allude. The engine is of the "marine" type, with cast-iron standards at the back which act as carriers for one side of the cylinders, this also carries guides for the piston rods; the front of the cylinder is supported by polished steel columns. The pistons are fitted with Mather and Platt cylinder rings packed throughout with metallic packing. The Pickering throttle governor is provided, and the engines are also fitted with hand regulation for the expansion gear, which is so arranged that the cut-off of the engine may be operated while running. The generators are of the Mather and Platt patent multipolar type at a voltage of 505; as will be seen they are coupled direct to each engine. They are of the six-pole type, shunt wound magnets and yoke casting in one piece, the top half of the machine can be easily removed, thus giving ready access to the armature; the latter is of a slotted series drum type. The brushes are of the laminated spring type, and a special feature about the machine is that there are no moving parts carrying current. In the same room are fixed three boosters; these consist of four-pole machines, one acting as a motor and one as a generator, the generating side being capable of developing 130 amperes at 200 volts. By an arrangement of the switches it is possible to connect any one of the boosters to any one of the feeders, so that the E.M.F. of the line at any given point may be regulated to any desired voltage. It is also possible, through the medium of other switches, to directly connect the boosters to feeders running to the accumulators placed at each end of the line, so that the batteries may be charged direct from the generating station. There is nothing unusual about the type of these machines; they are of the drum armature slotted type.

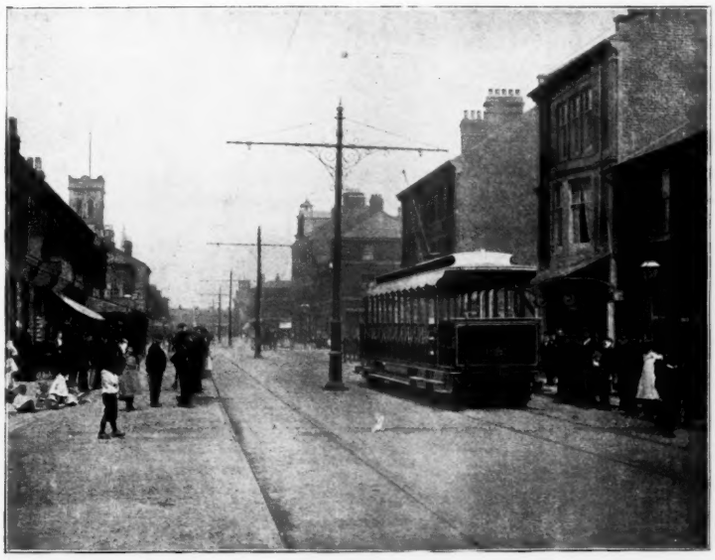


View of Cutting at Blackpool.

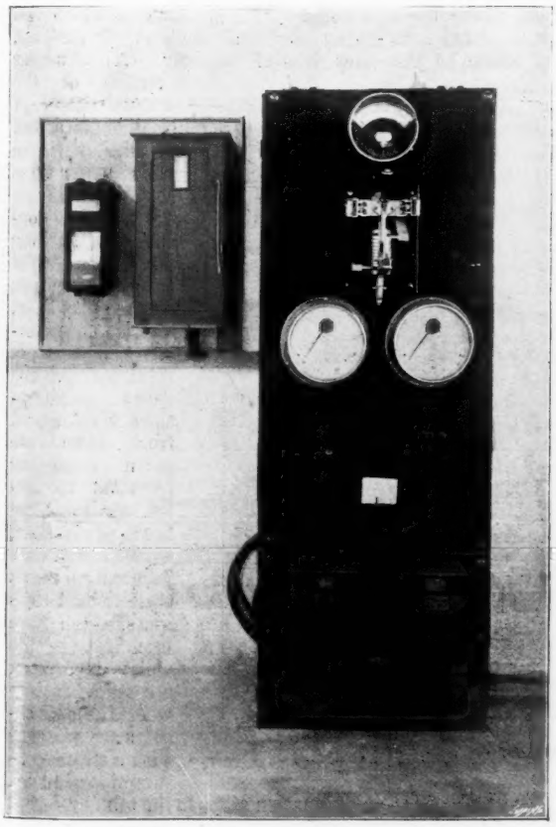
Street View in Blackpool.

Before leaving the generating station, it may be observed that there is the inevitable crane, which traverses not only the power house, but is also capable of being used in the car sheds, which adjoin the power house. There is nothing of special novelty about the switchboard; it is divided up into panels for the machines, and for the feeders there is the usual regulating arrangement, measuring instruments, and automatic circuit breaker, which latter are of the "Cutler" type, described in our article on the Halifax tramways. We have already said there are two accumulator stations, one at Blackpool and

one at Fleetwood, being practically at each end of the line. The accumulators are running parallel to the line, the object being to provide for any sudden rush of current which would occur, say, at the starting of several cars together; it also serves the purpose of running the early morning and late evening traffic. It will be remembered that in former descriptions of the Douglas and Laxey line a battery of accumulators was referred to as being used on this line for a similar purpose. There are 250 accumulators in each place, having a capacity of about 360 ampere-hours. A switch is provided in each accumulator house, mounted on iron, which contains switch ammeters, and the usual circuit breaker. The feeders are 37/14s lead sheathed, and armoured, having an insulation resistance of not less than 1,000 megohms per mile. These are laid in trenches alongside the line, and the necessary pilot wires are laid with them. The poles are of steel, made in this country, being 22 feet above the ground; the overhead conductor is ·348 inch in diameter, and it is divided into sections of half-miles. Section boxes are fitted with switching arrangements to disconnect any section, and the feeder boxes are also provided with switching arrangements to cut off the feeders from the overhead lines. The bonding of the rails has been done throughout with plastic bonds, and probably this is the first time such an arrangement has been used in this country. When the line is in full working order, and it will doubtless be opened to the public in a few days, the rolling stock will consist of 28 cars, nine closed, three trailers, and the remainder with open sides. Each car is provided with two motors of 35 H.P. of the usual closed type (gearing running in oil). The cars are carried on two steel four-wheeled bogey trucks, the wheels are 30 inches in diameter, and hand brakes are provided at each end. It might be mentioned that the motors are provided with spring suspension, and, moreover, the axles are finished with springs to compensate for lateral and vertical displacement. The usual series parallel controller is provided, and, in addition, an emergency switch is fixed to each end. The trolleys are of the usual swivelling type, which has become familiar on almost all the lines in this country. The whole of the electrical work has been carried out by Messrs. Mather & Platt under the direct supervision of Mr. R. H. Willis, the road work being carried out by Messrs. Dick, Kerr & Co. The line is being worked by a separate company, called the Fleetwood and Blackpool Electric Tramway Company. Although there is not the same attraction for riding on this line as occurs in the case of the Douglas and Laxey, and other Isle of Man lines, the system will, nevertheless, be of the greatest utility. The line will, to a great extent, supersede the railway which connects these two towns (Blackpool and Fleetwood) together, the journey on which is a somewhat protracted one and usually necessitates changing trains. It is proposed to run the cars between Fleetwood and Blackpool in something like 25 minutes, and with the number of cars already on the line, a fairly frequent service will be provided, and there seems little reason to doubt that this electric line will be a great success. We look upon it as a forerunner of numerous systems of electrically operated lines that will be eventually brought into existence along this coast.



Street View in Fleetwood.



Switchboard in Accumulator House.

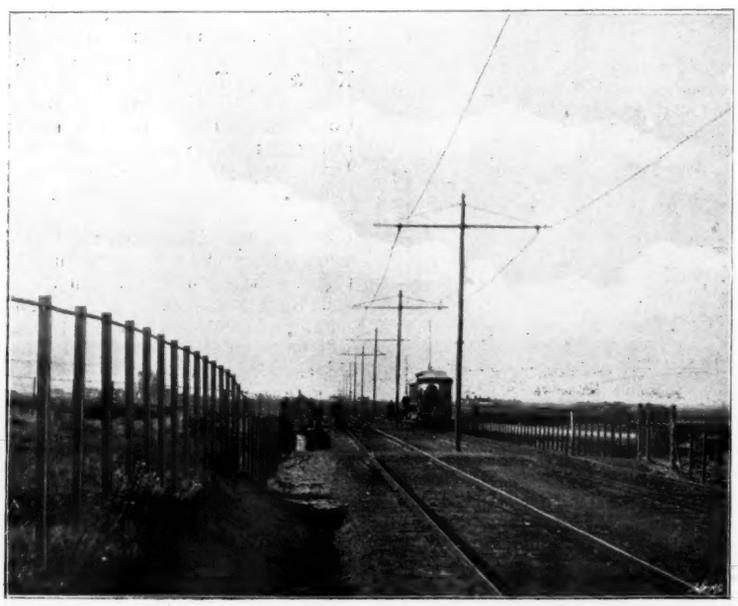
POWER DISTRIBUTION IN FACTORIES.

Although considerable progress has already been made in the introduction of electrical distribution of power in factories, the field is such a large one, that what has already been done is really but a drop in the ocean to what still remains. One of the greatest difficulties in the way of the general introduction of electrical power distribution is the want of actual figures, showing the saving effected in factories in which electrical methods have been adopted; as, naturally, the power user wants to see well authenticated figures, and not merely probable estimates of the return he will get for the capital to be expended on electrical plant. This difficulty is in great measure due to the impossibility of obtaining from the user of power an accurate statement of the average brake horse-power actually supplied to the driving

shafts of the machines, or of the pounds of fuel used per brake horse-power-hour. One can learn that there are a certain number of engines in use, each rated at so many horse-power, but in many cases no information can be obtained as to the number of horse-power-hours indicated per month or year, nor as to the percentages of the power which are actually applied to the shafts of the machines, or are wasted in engine friction and transmission. On the other hand, although the total bill for fuel and wages of stokers and engine tenders may be given, a considerable portion of this is chargeable in many factories to heating or other purposes other than the production of power.

Blackpool Tramway: Accumulator Room.

In a paper read before the Institute of Engineers and Shipbuilders in Scotland, Mr. H. A. Mavor has given in tabulated form the replies received from a number of manufacturers to inquiries addressed to them by him; and these tables, though interesting as showing the cost per indicated horse-power per hour for fuel, stores and wages, illustrate very well the difficulties named above; as in the majority of cases the information is incomplete owing to no figures being given for the percentage loss in transmission, or to the fact that the proportion of the cost of steam raising which is chargeable to power cannot be determined. The replies received have been divided by Mr. Mavor into two groups, one for weaving, spinning, thread, tweed, corn and flour mills and engineering works, in which power is derived from one or two main engines, and the other for paper mills, chemical, sugar refining and engineering works, in which power is derived from a number of small engines erected in various parts of the works. From a third table summarising the results of the inquiry, we find that for the first group the average coal consumption per indicated horse-power-hour is 3·1 lbs., the average price paid for coal is 5s. 5d. per ton, and the average cost per indicated horse-power-hour for fuel is ·091d., for oil and petty stores ·011d., and for labour ·028d., making a total of ·13d. The corresponding figures for the second group are as follows:—the average coal consumption is 5·3 lbs., the average price paid for coal is 6s. 4d. per ton, and the average cost per indicated horse-power-hour for fuel is ·18d., for oil and petty stores ·01d., and for labour ·034d., making a total of ·224d. Judging from these average figures, the difference between the two groups is not so marked as we should have expected; but this small difference is due in part to the fact that the averages have been calculated from the total horse-power-hours, and the total costs of all the factories added together, and as the larger users of power have obtained better results than the smaller users, the average figures are proportionately better. If, instead of using this method, we take the coal consumption of each factory, add them together, and then get the average by dividing by the number of factories, we arrive at 10·5 lbs. instead of 5·3 lbs., and we may also note that the heaviest coal consumptions are in engineering works, the actual record figure quoted being for an engineering establishment where the coal consumption amounts to 27·85 lbs. per indicated horse-power-hour, and the cost for fuel, oil, and labour to just over ⅔ths of a penny. As a further example of the wastefulness of small engines, and of the way in which power users sometimes allow engines to consume steam long after they ought to have been put on the scrap heap, a series of indicator diagrams are reprinted, and the steam consumptions as calculated from them are given as ranging from 53 to 180 lbs. per indicated horse-power-hour, with the additional information that these small engines, which have been in use for about 20 years, are in a factory where the main engines are working with a steam consumption of 14 lbs.



Blackpool Tramway: View of Track.

To supplement the information given in the tables referred to above, Mr. Mavor gives particulars of the economical results obtained at a foundry in Glasgow, where 19 small engines were replaced by a gas engine of 120 horse-power driving a set of hydraulic pumps and a dynamo. The hydraulic gear works lifts, cranes, and testing apparatus, whilst the dynamo supplies current to seven motors of various powers for driving cranes and machine tools, and also for

lighting a portion of the works formerly lighted by gas and oil lamps. A comparison was made between two months, one before and one after the change, in which the output of manufactured product and the work done were the same, and the books show that in the earlier period, 566 tons of dross costing £127 were consumed, whilst in the second period 227 tons of dross and 26 tons of anthracite, costing together £67, were consumed. The net result of the change was therefore a cash saving of £60 per month in cost of fuel, whilst the total saving in working expenses was estimated at from £80 to £100 per month.

Mr. Mavor concludes his paper by some advice as to the best way to effect a change from the old style to the new, so as to show a good return for the capital expenditure from the start. He considers that it is a bad plan to use an old engine to drive a dynamo, or to put down a new engine to take steam from an old low-pressure boiler, and advises that a separate installation of boilers, engines, and dynamos of efficient type, should be erected sufficient in the first instance to allow of all the notoriously wasteful isolated engines being replaced by electric motors, whilst leaving untouched any old engines which are working with fair economy, and especially those which are driving groups of machines through shafting. When all the isolated engines have been replaced, and the economy effected by the change is known, the question of how far it will pay to do away with main engines and shaft transmissions, and replace them by electrical transmission can then be safely answered, and the change gradually made.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 122.)

Stoke-upon-Trent.—The British Electric Traction Company, Limited, intend to apply to the Board of Trade to extend the time for completing the tramway extensions until February 7th—an extension of six months.

Worcester and Staffordshire Tramways.—The Board of Trade have conceded the application of the British Electric Traction Company to construct a network of tramways for the South Staffordshire and Worcestershire districts.

Yarmouth.—A very lengthy and interesting discussion took place at a meeting of the Great Yarmouth Town Council on Tuesday last week on a question of supplying electricity. The Yarmouth and Gorleston Tramway Company propose to substitute electricity on one of their horse lines, and to put down plant for public and private lighting at Gorleston and Southdown. The Corporation is divided in opinion as to whether they shall exercise their own powers in the district or allow the company to take their place. To carry wires over the river would cost £600, to lay cables under it would involve an outlay of £2,000; and it would be necessary to have additional dynamos. The Electrical Lighting Committee recommended the Council to grant the company a concession for supplying Gorleston and Southdown with electricity for traction and lighting purposes, provided details can be satisfactorily arranged for safeguarding the interests of the Corporation and of the private consumer. This, however, was defeated, and an amendment, carried by 19 to 10, to appoint a committee, to confer with experts, if necessary, as to whether it is expedient for the Corporation to part with their powers, and if so, at what price, and on what conditions.

TELEGRAPH AND TELEPHONE NOTES.

Cable Communication with Spain Restored.—The Direct Spanish Telegraph Company, Limited, state that the direct cable communication with Spain *viâ* Bilbao is now restored.

Hawaiian Cable.—A Reuter despatch dated Honolulu, July 6th, says that the Hawaiian Government has signed a contract with Messrs. Scrimser & Co. for the laying of a cable to the United States.

Telegraphic Communication with Iceland.—Mr. Doughty, M.P., writes to the *Times* enclosing a copy of a memorial presented by him on behalf of the signatories to Mr. Balfour advocating a scheme for the establishment of telegraphic communication between Great Britain and Iceland and also the Faröe Islands. The memorial is signed by the following members of Parliament in addition to Mr. Doughty:—Mr. C. H. Wilson, Mr. Firbank, Mr. Garfit, Mr. Pirie, Mr. Doxford, Sir Angus Holden, and Mr. Compton Rickett. It states that telegraphic communication is of great importance to the Admiralty and to meteorological science, as well as to the further development of trade, and particularly to the fishing industry. The Great Northern Telegraph Company of Copenhagen, whose cables connect Great Britain with the three Scandinavian countries and with Russia, has received promises from the Danish Government of a concession for a cable from Great Britain (Shetland Islands) to Iceland, *viâ* the Faröe Islands, with subsidies to the amount of £5,000 per annum for 20 years. Ever since its formation in 1869 the company has contemplated laying such a cable, and that it has not succeeded hitherto is due to the fact that the commerce of the Faröe Islands and Iceland is as yet not large enough to justify the expectation of a telegraphic traffic producing a sum anything like sufficient to cover the expenses of the undertaking. With a capital fixed at £100,000, the lowest amount for which it would be possible to establish the line in a satisfactory manner, the expense per annum is estimated at £13,200 a year. The traffic revenue could not at the utmost be expected for some years to exceed £2,000 per annum, and this, with the Danish Government subsidy, leaves £6,200 to be made up. If Her Majesty's Government would grant a subsidy of £3,000 a year for 20 years the company would lay the cables and work the lines. As, however, the Government might hesitate to grant a subsidy to a foreign country, the memorialists suggest that the grant of £3,000 might be officially made as an additional grant to the Meteorological Office, which in turn could hand it over to the company as a set-off against the free transmission of meteorological telegrams.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1898 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Caimanera-Santiago de Cuba }	June 10th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Maranham-Para	April 17th, 1898 ...	July 15th, 1898
Hong Kong-Manila	May 3rd, 1898 ...	...
Bilbao-Falmouth	July 9th, 1898 ...	July 14th, 1898
Landlines.		
Trans-Continental line beyond Masol }	March 12th, 1898 ...	...
Cartagena-Barranquilla ...	July 4th, 1898 ...	...
Saigon-Bangkok	June 14th, 1898 ...	July 14th, 1898

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking.—August 3rd. The Council wants tenders for the supply and delivery of electric meters and main cut-outs for a period of 12 months, also for the supply of lamp brackets and columns, and for the free wiring of premises in the district. Mr. W. C. C. Hawtayne is consulting engineer. See our "Official Notices" this week for particulars.

Belgium.—August 1st. The municipal authorities of Stavelot are inviting tenders until August 1st for the concession for the supply of electrical engines for lighting and power purposes in the town during a period of 30 years. Tenders to be sent to L'Administration Communale de Stavelot (Belgium). Particulars from the Secretariat de la Ville on payment of 4 francs.

Dublin.—July 23rd. The Great Northern Railway Company (Ireland) invite tenders for complete electric lighting installation for the premises at Amiens Street Terminus, Dublin. Specification from the secretary.

Eccles.—July 23rd. The Corporation of Eccles are prepared to receive tenders for the wiring of the Town Hall. See our "Official Notices" July 15th.

Exeter.—July 25th. The Corporation require tenders for high and low tension concentric mains, transformers, meters, and a feed water heater. See our "Official Notices" July 8th.

France.—The French Post and Telegraph Department in Paris is inviting tenders until the 26th inst. for the supply of 100 tons of homogenous iron wire 2½ mm. in diameter, 120 tons of ordinary galvanised iron wire 7 mm. in diameter, and 200 kilometres of submarine cable core. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, from whence particulars may be obtained.

Hapton.—August 1st. The Parish Council ask for tenders for lighting the district by electricity to be sent to the clerk.

London.—August 15th. The managers of the Central London Sick Asylum District are inviting tenders for electric lighting plant for the new asylum, Hendon, Middlesex. Specification, &c., from the architects, Messrs. Giles, Gough & Trollope, 38, Craven Street, Charing Cross, W.C. See our "Official Notices" this week for particulars.

Melbourne.—Tenders are asked by the Melbourne City Council for 600,000 arc lamp carbons. See our "Official Notices" July 8th.

Pemberton (Lancashire).—The Urban District Council ask for schemes for lighting the district by electricity. See our "Official Notices."

Russia.—Tenders are being invited until August 13th next by the municipal authorities of Tiflis, for the erection and equipment of a central station for the electric lighting, by means of arc lamps, of the public streets in the centre of the town. Particulars may be obtained from, and tenders to be sent to, La Mairie de Tiflis, Russia.

Shanghai.—August 10th. The Shanghai Municipal Council invites tenders for the supply of two 100-kw. direct coupled steam alternators, switchboard, and water-tube boiler. Particulars and specifications to be obtained from Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, E.C., to whom tenders have to be sent. See our "Official Notices" June 24th.

St. Mary, Newington.—July 22nd. The Vestry ask for tenders for supply and laying of insulated mains, conduits, boxes, &c. See our "Official Notices" July 8th.

Wigan.—Tenders are asked for the electric lighting of the Drill Hall on the occasion of the Wigan Trades, Commercial and Art Exhibition to be held from October 26th to December 7th. See our "Official Notices" July 15th.

CLOSED.

Belfast.—The Corporation has accepted the tender of the General Electric Company for the supply and erection of a station switchboard. All consumers are now changed over to 220 volts pressure.

Llandudno.—A daily contemporary says that the District Council have decided to order electrical meters to meet present requirements from the Penny-in-the-slot Electric Supply Syndicate and from Messrs. Ferranti, Limited.

London.—The London County Council on Tuesday received a report by the Main Drainage Committee on the 16 tenders submitted for the wiring, lamps, and fittings, required in connection with the electric lighting of the Crossness outfall works. In the list of tenders, published in the Electrical Review on June 24th, the offer of Messrs. Fowler & Lancaster was given as £2,560, instead of £1,560. As, however, will be seen from the following statement by the Main Drainage Committee, the former sum was intended to have been quoted by the company:—"Since the opening of the tenders on June 21st, Messrs. Fowler & Lancaster, Limited, have by letter, dated June 29th, asked that the amount of their tender may be increased by £1,000, but we presume the Council will consider it inadvisable to entertain the amended offer. The next lowest tenderers, the National Electric Free Wiring Company, Limited, stipulate for a mode of insulation which is their patent and does not comply with the Council's requirements. We are, moreover, informed that the system suggested is unsuitable for damp underground work in the precipitation channels, and, under the circumstances, we think the tender of Messrs. J. H. Pickup & Co. should be accepted." The committee accordingly recommended the acceptance of the tender of that company for £2,712 19s. 7d. The recommendation was adopted.

London.—The St. Pancras Vestry, in connection with the additional plant required for the Regent's Park station, received the under-noted tenders for the supply of condensing plant, steam pipes, &c.

	£	s.	d.
Meehan & Sons	5,000	0	0
Klein Engineering Company, Limited	4,875	0	0
G. Wailes & Co.	4,306	10	10
John Fraser & Son	4,155	14	4
*T. Ledward & Co.	3,097	0	0
*Fairbrother & Co.	3,231	0	0

* Do not comply with specification.

The tender of Messrs. John Fraser & Son, of Millwall, has been accepted. The Vestry have also accepted at £496 17s. 2d., the tender of Messrs. Reid Bros., for supplying and laying cast-iron pipes for condensing purposes from the King's Road station to the canal of the North Metropolitan Railway and Canal Company.

London.—The Main Drainage Committee reported to the London County Council on Tuesday, having considered the seven tenders referred to them for the supply of engines, dynamos, and accumulators required in connection with the electric lighting of the Crossness outfall. The list of tenders was given in the Electrical Review of June 24th. The committee stated that as Messrs. Fowler & Co. only tendered for two dynamos and accessories they were unable to consider the offer, and that they could not advise the Council to entertain the next lowest offer. Messrs. Calvert & Co. proposed to supply engines of the Willans type, and Messrs. Scott, Anderson & Beit, an enclosed compound engine made by Messrs. Mirrlees, Watson & Co. Both these firms had, therefore, not tendered in accordance with the specification, and after conferring with the engineer the committee concluded that the tender of the Safety Concentric Wiring Company, who proposed to adhere to the type of engine specified, should be accepted. The committee accordingly recommended the acceptance of the offer of that company for £4,990, the contract to be completed in five months. The recommendation was adopted.

Paris.—Messrs. Babcock & Wilcox, Glasgow, are stated to have secured the contract for the boilers for the Paris electric tramways.

Southampton.—Last week the Electric Lighting Committee reported the receipt of the following tenders for the supply, delivery, and erection of 62 arc lamps and columns, viz.:—

Crompton & Co., Limited	£2,035
W. Lucy & Co.	£2,354
British Blahnik Arc Light Company ..	£2,892
Brockie-Pell Arc Light Company	£2,400
Johnson and Phillips	£2,578

Subject to Mr. Manville's approval, the committee recommended the Corporation to accept the tender of Messrs. Crompton & Co., Limited, at £2,035. Subsequently the Brockie-Pell Company submitted an amended tender of £2,200, and failing Messrs. Crompton and Co., the committee recommended the acceptance of that one. The electrical engineer reported that the number of units metered at the works during June was 11,290, an increase of 1,550, or 16 per cent. over that for June, 1897. The smallness of the increase was due to the fact that in June, 1897, the output was abnormally large, owing to the Jubilee. Alderman Bone proposed the adoption of this paragraph, mentioning that Messrs. Crompton & Co. were approved by Mr. Manville and the committee. This was agreed to.

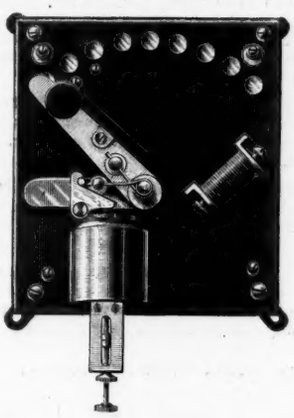
NOTES.

Fire at Sunderland.—We understand that owing to a disastrous fire which completely gutted the central part of the town on Monday night, the Corporation electricity supply was cut off at 10.40 p.m., due to the burning out of some of the heavy mains, which were dislocated after the fall of one of the massive buildings. The alternating district was supplied again within five minutes of the accident, and the whole of the supply, excepting the part actually affected was on again in an hour from the time of the accident, and would have been connected earlier had it not been for the trouble experienced in getting to the disconnecting boxes (owing to the dense crowds which thronged all approaches to the district). Great credit is due to the staff for the splendid way in which they acquitted themselves in the emergency. But for their hard work the current must have been off for a much longer period.

Petroff or Sir Humphry Davy?—Who was the first to discover the electric light? Our belief up to the present has been that it was Sir Humphry Davy, in 1813, but *il faut changer cela*, as it now appears that it was Vassili Petroff, a Russian professor, who accomplished the deed in 1802. This is what we read in a note in the Russian edition of the "Cours d'Electricité," by Eric Gérard, which has been inserted by the translator, M. A. Chatelain, who calls it an historic rectification. Almost all the electrical books published on the Continent tell us that Sir Humphry Davy discovered the electric light in 1813, and, no one will hesitate in acknowledging that Russia is rather slow in recognising the services of her scientists, since it took her not less than 96 years to become aware of the existence of the 2,400-cell battery which allowed Petroff to strike the electric arc before Sir Humphry Davy.

Worcester Waterworks Motors.—With reference to Messrs. Geipel & Lange's communication in our last issue, we have received a letter from Mr. E. E. Hoadley, dated 14th inst., in which he says that the statement that the motors were supplied by the Oerlikon Company was, of course, a clerical error, the motors being supplied by Messrs. Brown, Boveri & Co. through their agents in this country.

Under Voltage and Overload Automatic Motor Starter.—We illustrate below the latest type of under voltage and overload automatic motor starter of the Ward Leonard Electric Company, Bronxville, N.Y., for motors of moderate size. The patented double lever, which has met with much favour, is retained in this type. The switch lever is held normally closed by a latch which, upon overload current, is released by the plunger of the vertical solenoid magnet. The rheostat lever is normally held closed by a magnet in the main circuit, so that in case the current fails the rheostat lever automatically moves back to the starting position. The switch parts are mounted upon a slate front as shown. This slate forms the front side of a shallow cast-iron box in which the resistance wire is placed. The resistance coils are imbedded in a mass of material which is highly insulating and



has a very high capacity for the absorption of heat energy developed in starting the motor. No asbestos, enamel, cement, or other materials are employed in this rheostat, for which the Ward Leonard Company makes the strongest claims. While the Ward Leonard Company claims superiority for this rheostat on every point, it is offering it to the trade at one-half the price it has heretofore quoted for similar apparatus. It explains that this is due to careful design, special tools, and new economical processes of manufacture, together with the greater cheapness due to manufacturing in very large quantities.

Presentation.—We hear that on Friday evening last an interesting presentation was made at 43, Burnaby Gardens, Chiswick, to Mr. Hugh Ross MacDonald, who for the last 20 years has been connected with the commercial part of the Eastern Telegraph Company, Winchester House, Old Broad Street, City. Mr. MacDonald has just retired from the company's service. A deputation representing the Eastern Telegraph Company, the Eastern Extension Telegraph Company, Direct United States Telegraph Company, Brazilian Submarine Telegraph Company, Globe Telegraph Company, and many other associated cable companies, waited on Mr. MacDonald at his private residence for the purpose of presenting him with a gold watch and chain and a purse of sovereigns, as a mark of appreciation for his long business connection with them. Mrs. MacDonald was presented with a gold bracelet with heart pendant attached.

Award.—As a result of the examinations recently held at the Electrical Standardising, Testing and Training Institution, Mr. F. M. Denton, of Hymer's College, Hull, has been awarded an Exhibition of the value of 40 guineas, tenable for two years.

Electric Light for the Vatican.—From January 1st, 1899, says a daily paper, the Vatican will be lighted throughout by electricity. Preparations for the installation have already been commenced. The motor power will be supplied by water flowing at a quick rate of speed from Lake Bracciano, which lies high up in the mountains 20 miles north of Rome. The Pope is declared to be taking great interest in the work.

Wireless Telegraphy.—A daily paper says that on Wednesday the proprietors of the Dublin *Daily Express and Evening Mail* successfully carried out a series of experiments in wireless telegraphy. Signor Marconi himself went over to conduct the trial, which consisted of a description of the Royal Alfred Yacht Club Regatta. The wireless messages were sent from a steam tug, which followed the races, and the distance of water traversed by the telegrams varied from five to ten miles. Not a hitch occurred, the instruments working splendidly; and not a single message had to be repeated. Signor Marconi was himself the operator in the cabin of the tug, and the messages were received by his chief assistant, Mr. Kemp, at the land station in Kingstown. Thence they were telephoned to the offices of the *Mail*. The tug followed the competition throughout, Signor Marconi sending off at frequent intervals descriptions of the progress of the contest, dictated by a yachting expert on the bridge. These messages were invariably received at the *Mail* office a few minutes after their despatch, and were published in successive editions.

Personal.—Mr. John Hart informs us that he has resigned his position as secretary and manager of Messrs. H. M. Salmony & Co., Limited.

Appointment Vacant.—The Wolverhampton Lighting Committee want a junior assistant electrical engineer at a salary of £80 per annum. See our "Official Notices" this week for details.

A Lectureship Vacant.—It will be seen from our "Official Notices" that the Council of the Durham College of Science is inviting applications for a lectureship in electrical engineering.

Institution of Junior Engineers.—The summer meeting of the Institution of Junior Engineers, of which Mr. John A. F. Aspinall (L. and Y. Railway) is president, is to be held at Liverpool, from August 8th to 13th. The president-elect is Sir William H. White, of the Admiralty.

The Admiralty and Electric Driving.—The Admiralty are stated to be considering an immense extension of electricity for the Portsmouth dockyard, at an estimated cost of £250,000. It is intended to abolish the old steam boilers and to drive the whole of the machinery by electricity, the generating station being the site upon which the convict prison stood.

Changes which Take Place in the Clark Cell.—The zinc sulphate in the Clark cell appears to undergo certain changes which Wilhelm Jaeger has recently been investigating (*vide Annalen der Physik und Chemie* (II.), 63, 354). At 39° the ordinary crystals of zinc sulphate, $Zn\,SO_4 + 7\,H_2O$, change into crystals of the composition, $Zn\,SO_4 + 6\,H_2O$. There is a break in the solubility curve at this point, the solubility of the new salt being greater than that of the original compound. In keeping with this, the E.M.F. of the Clark cell shows a change at 39° on heating, and it is possible to cool the cell down to the ordinary condition, abnormal values for the E.M.F. being thus obtained at ordinary temperatures. Two curves are thus obtained for the E.M.F. of the Clark cell. For the normal cell containing $Zn\,SO_4 + 7\,H_2O$,

$$E_t = 1{\cdot}400_5 - 0{\cdot}00152\,(t - 39) - 0{\cdot}000007\,(t - 39)^2.$$

For the abnormal cell containing Zn SO + 6 HO,

$$E_t = 1{\cdot}400_5 - 0{\cdot}00102\,(t - 39) - 0{\cdot}000004\,(t - 39)^2.$$

After using the Clark cell, care should be taken not to raise the temperature above 40°, and to make certain that the zinc sulphate is present in its normal state.

Appointments.—It is stated that Mr. W. J. Horne, demonstrator in electrical engineering at the Heriot-Watt College, Edinburgh, has been appointed assistant lecturer in physics and engineering at the South African College of Science, Cape Town.

We understand that Mr. Arthur J. Mayne (late with New and Mayne, Limited), has secured the appointment by the War Office of electrical engineer for Aldershot Camp, which was mentioned in our issue of June 17th.

The Bermondsey Order.—The House of Commons Committee yesterday again considered the matter of the Bermondsey Vestry provisional order. After hearing counsels' speeches and consulting in private, the committee said that they had hoped that some friendly arrangement might have been made which would have been advantageous to both parties. That not having been done, they had only one duty to perform, which was to give their decision upon the question of the confirmation of the order, and they found that the order was confirmed.

NEW COMPANIES REGISTERED.

Electric Night Advertising Company, Limited (58,168).—This company was registered on July 12th, with a capital of £3,000 in £1 shares, to acquire the business carried on by John T. Gent, John S. Richardson and Ernest Pilling, at 53½, Suffolk Street, Birmingham, and to carry on the business of illuminated advertisers and contractors, manufacturers of advertising appliances, electric light and gas engineers, &c. The subscribers (with one share each) are:—Mrs. M. Gent, 12, Brighton Road, Birmingham; E. Pilling, 4, Prospect Road, Moseley, Birmingham, electrical engineer; W. A. Gent and J. T. Gent, 12, Brighton Road, Birmingham, electrical engineers; F. Lomax, 27—29, Freeman Street, Birmingham, merchant; G. F. Lomax, Alcester Road, Moseley, Birmingham, clerk; E. Richardson, 41, Waverley Road, Small Heath, manager. J. S. Richardson and E. Pilling are joint managing directors.

Electric Royalties Syndicate, Limited (58,177).—This company was registered on July 12th, with a capital of £10,000 in 9,950 ordinary shares of £1 each, and 1,000 deferred shares of 1s. each, to acquire, own, and work certain undescribed patents, inventions, and rights. The subscribers (with one share each) are:—J. H. Coley, 57, Rutland Road, Ilford, clerk; T. Atkinson, 3, Pancras Lane, E.C., clerk; J. Calvert, 4, Bishopsgate Street, E.C., stockjobber; J. Cartwright, 1, Vernon Terrace, Hornsey, clerk; A. Johnson, 109, Calabria Road, Highbury, retired; G. Sakhein, 40, Queen Street, E.C., merchant; J. Ward, 6, Quentin Road, Blackheath, mechanical engineer. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, 50 shares; remuneration, one guinea each per board meeting attended.

Crystal Electric Lamp and Rose & Bird, Limited (58,218).—This company was registered on July 14th, with a capital of £50,000 in £1 shares (10,000 preference), to acquire the business carried on by French & Griffith, at Bedford and elsewhere, (which was formerly carried on by the Crystal Electric Lamp Company, Limited), and the business carried on in London by Rose & Bird, Limited, to adopt an agreement with F. W. French and M. Griffith, and to carry on the business of electric lamp manufacturers, electricians, electrical, gas, and mechanical engineers, suppliers of electricity, &c. The subscribers (with one share each) are:—H. Lovegrove, Dalmeny, Sutton, gentleman; A. H. Naylor, 29, Granville Road, Stroud Green, N., clerk; E. A. Norrington, 11, Ackroyd Road, Honor Oak Park, S.E., clerk; H. E. Norton, 3, Lynton Road, Leytonstone, clerk; F. S. Wiggins, Lyndhurst, Langley Park, Sutton, clerk; F. Fricker, 12, Marlboro' Road, Lee, S.E., clerk; H. S. Deacon, St. Stephen's Chambers, Telegraph Street, E.C., secretary. The number of directors is not to be less than two nor more than three; the first are Frederic W. French, Herbert W. Griffith, and Henry Lovegrove; qualification, £250; remuneration as fixed by the company. Registered office, St. Stephen's Chambers, Telegraph Street, E.C.

Wenlock Electrolytic Company, Limited (58,260).—This company was registered on July 18th, with a capital of £120,000 in £1 shares, to adopt an agreement with the Wednesfield Chemical Syndicate, Limited, to acquire, own, and work any patents and inventions connected with the production, treatment, storage, application, and use of electricity, and to carry on the business of chemical and manure manufacturers, distillers, dye and gas makers, metallurgists, engineers, &c. The subscribers (with one share each) are:—A. Saville-Cohen, 129, Highbury New Park, N., gentleman; E. T. Church, 48, Geneva Road, Brixton, clerk; J. M. Lickfold, 33, Brunswick Square, W.C., journalist; E. Wyatt, Lausanne Road, Hornsey, gentleman; H. W. Brown, 79, High Street, Beckenham, gentleman; H. Spinks, 59, Church Road Homerton, N.E, clerk. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £500 per annum divisible.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Eastern Extension, Australasia, and China Telegraph Company, Limited (7,224).—This company's annual return was filed on June 2nd, when 250,000 shares were taken up out of a capital of £3,000,000 in £10 shares, and paid for in full.

Western and Brazilian Telegraph Company, Limited (7,251).—This company's annual return was filed on June 30th. The capital is £1,500,000 in 66,871 shares of £15 each and 66,258 shares of £7 10s. each. 64,269 of the former and all the latter have been taken up, and the full amount has been called. £1,460,970 has been paid, and £565 has been received on 75 forfeited shares.

West Coast of America Telegraph Company, Limited (52,114).—This company's return was filed on May 28th, when 45,000 shares were taken up out of a capital of £132,520 in £2 10s. shares, and considered as fully paid.

New General Traction Company, Limited (47,321).—This company's annual return was filed on June 1st. The capital is £270,000 in 24,000 ordinary and 30,000 preference shares of £5 each. All the former are considered as paid, and the latter have had the full amount paid up and received on them.

Harrow Electric Light and Power Company, Limited (44,529).—This company's return was filed on June 16th, when 3,550 shares were taken up out of a capital of £25,000 in £5 shares, and paid for in full.

West African Telegraph Company, Limited (21,626).—This company's return was filed on July 7th, when 23,109 shares were taken up out of a capital of £400,000 in £10 shares, and paid for in full.

British Thomson-Houston Company, Limited (47,982).—This company's return was filed on July 8th, when the whole capital of £240,000 in £10 shares was taken up. 7,469 are considered as fully paid, and the full amount has been called and paid on the others.

Callender's Cable and Construction Company, Limited (48,915).—This company's annual return was filed on July 4th, when the whole capital of £100,000 in £5 shares was taken up and paid for in full.

CITY NOTES.

The National Telephone Company, Limited.

THE directors' report for the half-year ending June 30th, 1898, to be presented to the shareholders at the twenty-second ordinary general meeting of the company, to be held at the Cannon Street Hotel, on Wednesday, July 27th, 1898, at 1 o'clock p.m., reads as follows:—

"The income accrued in respect of the business of the half-year amounts to £538,866 0s. 8d. as compared with £476,953 17s. 8d. for the corresponding period of 1897, being an increase of £61,912 3s. The working expenses for the half-year amount to £298,651 as compared with £261,796 9s. 3d. for the corresponding period of 1897, being an increase of £36,854 10s. 9d. The net result for the half-year (after deducting the Post Office royalties amounting to £49,664 12s. 8d.) is a profit balance of £190,550 8s. as compared with £171,978 9s. for the corresponding period of 1897, being an increase of £18,571 19s. The rentals carried forward for unexpired terms of running contracts amount to £565,620 5s. 4d. as compared with £499,962 17s. 8d. at the corresponding period of 1897, or an increase of £65,657 7s. 8d. Out of the available balance of £167,853 18s. 4d. shown by the net revenue account (No. 3) the board will recommend the payment of a dividend at the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares, 5 per cent. per annum, less income-tax, on the third preference shares, and 6 per cent. per annum, free of income-tax, on the ordinary shares. The board also propose to transfer £50,000 to the reserve fund, and to carry forward the balance of £4,914 7s. 4d. *Capital Expenditure.*—The sum of £315,305 11s. 3d. has been expended on capital account during the half-year in the erection of 6,581 additional exchanges and private lines, and in the construction of underground lines. *Retiring Directors.*—At the general meeting four directors retire, and being eligible offer themselves for re-election, viz., Mr. James Staats Forbes, the Rt. Hon. Sir James Fergusson, Bart., G.C.S.I., M.P., Mr. Eli Heyworth, and Mr. Samuel Herrick Sands. *Retiring Auditors.*—The auditors, Messrs. Welton, Jones & Co., also retire and are eligible for re-election."

The Direct United States Cable Company, Limited.

THE directors' report for the six months ended June 30th, 1898, to be presented at the meeting to be held at Winchester House, on Tuesday July 26th, 1898, at 2 o'clock, p.m., says that the account for the half-year ended June 30th, 1898, together with the half-year's accounts to December 31st last, presented at the ordinary general meeting on January 25th last, show the financial result of the twenty-first year's working of the company. The half-year's revenue, after deducting out-payments, amounted to £52,232 12s. 1d., as compared with £43,892 8s. 3d. for the corresponding period of 1897, being a

difference of £8,340 3s. 10d. in favour of the half-year under review. It may be noted, however, that a portion of this considerable increase must be attributed to exceptional causes. The working and other expenses for the same period, including income-tax, but exclusive of cost of repairs of cables, amounted to £21,685 12s. 6d., leaving a balance of £30,546 19s. 7d. as the net profit, making with £4,090 2s. 2d. brought forward from the previous half-year, a total of £34,637 1s. 9d. For the corresponding period of 1897, the working expenses and other payments amounted to £19,559 15s. 5d. Three quarterly interim dividends of 3s. each per share, amounting to £27,319 10s. 0d., have been declared and paid during the financial year, and a final dividend of 3s. per share is now proposed, together with a bonus of 1s. per share, making, with the three interim dividends, 3½ per cent. for the year, being a total distribution of £39,461 10s. After transferring £10,000 to the reserve fund account, the balance of £3,388 11s. 9d. on the revenue account is proposed to be carried forward. The reserve fund account has been debited with £8,260 18s. 8d. for cost of cable repairs, and with £2,000 written off the Ballinskelligs buildings account, and after being credited with interest on the investments, and sum transferred from revenue account, the balance of the reserve fund now amounts to £351,455 2s. 9d. The station and staff buildings at Ballinskelligs are now completed, the cost of which, with the exception of the £1,324 11s. 5d. shown in the balance-sheet, has been charged to reserve. Pursuant to the provisions of the articles of association, two of the directors, viz., Admiral of the Fleet, the Hon. Sir Henry Keppel, G.C.B., D.C.L., and John Varley, Esq., retire by rotation, and, being eligible, offer themselves for re-election. Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. J. and J. Sawyer & Co., the auditors, retire pursuant to the articles of association, and offer themselves for re-election.

The Globe Telegraph and Trust Company, Limited.

THE directors' report, to be submitted to the general meeting on July 26th, reads as follows:—The balance-sheet and accounts for the year ended July 18th, 1898, with statement of the stocks and shares held by the company at that date, are herewith submitted. The net revenue of the company for the year, after deduction of expenses, amounts to £196,974 8s. 10d., and makes, with the balance of £2,022 19s. 4d. brought forward, a total of £198,997 8s. 2d. From this amount there has been distributed the sum of £132,372 8s. 10d. in interim dividends, leaving an available balance of £66,624 19s. 4d. The directors recommend the payment of a final dividend for the year of 3s. per share on the preference shares, and of 4s. 3d. per share on the ordinary shares, making, with previous distributions, a total dividend for the year of 6 per cent., less income-tax, upon the preference, and 5½ per cent. net (against 4½ per cent. for the preceding year) upon the ordinary shares, leaving a balance of £2,225 4s. 7d. to be carried forward to the next account. The directors have, during the year, continued their policy of distributing the investments of the company over a larger area. The directors deeply regret to record the loss of their esteemed colleague, the late Lord Sackville Arthur Cecil, who died in January last. J. Denison Pender, Esq., and Sir Albert J. Leppoc Cappel, K.C.I.E., have since been appointed to the board. In conformity with the articles of association, one of the directors, viz., the Right Hon. St. John Brodrick, M.P., retires, and, being eligible, offers himself for re-election. The directors regret to report the death of Mr. William Griffith, B.A., one of the company's auditors. Mr. John Newton has been elected in his place, in terms of the company's articles of association. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Mr. John Newton, retire, and offer themselves for re-election.

Fleetwood and District Electric Light and Power Syndicate.

THE prospectus of this syndicate, which will be found in full in our advertisement pages, states that the syndicate has been formed to work the District Council's provisional order, which has been transferred to it on very favourable terms. The company will, under the advice of Mr. F. H. Medhurst, consulting engineer, utilise the refuse of the district for steam raising. An arrangement has been made with the Council, by which the syndicate will be paid 1s. 3d. per ton for every ton of refuse burnt in the destructor. The system advised is the three-wire, direct current, low tension system, with 440 volts between the two outside conductors. In his report, which accompanies the prospectus, Mr. Medhurst estimates the capital outlay on a combined refuse destructor and electricity supply scheme for the public lighting of all the streets, and for private lighting for about 6,000 10-C.P. lights, including buildings, mains, engines, dynamos, &c. (in fact, inclusive of everything), at £25,000. "The gross revenue should not be less than £4,600, and the working expenses, including directors' fees, office rent, and all management charges, cannot well exceed £1,300 per annum; to this should be added upkeep and depreciation, at, say, £1,000 per annum, leaving as net profit £2,300, equal to over 9 per cent. on the capital outlay."

The District Council will light the whole district at 4d. per unit. The syndicate has made an agreement with the National Electric Free Wiring Company. A contract has been entered into with the Electrical Development and Finance Corporation to carry out the whole scheme for the inclusive sum of £25,000. The share capital is £22,000 in ordinary and deferred shares, and there are £7,000 4 per cent. debentures. Interest has been guaranteed on the ordinary shares at the rate of 5 per cent. for the first three years. For other particulars regarding the company, directors, &c., see the prospectus elsewhere.

Electrical Power Storage Company.

THE ninth ordinary general meeting of the shareholders of this company was held on Thursday, July 14th, at the offices, 4, Great Winchester Street, Mr. John Irving Courtenay, presiding.

Mr. DAVID SMITH (secretary) having read the advertisement convening the meeting, the report was taken as read.

The CHAIRMAN, in moving the adoption of the report, said: Gentlemen, the balance-sheet which has been sent to you shows, after payment of debenture interest, a net profit for the year of £4,389 6s. 5d., which, together with the sum of £242 0s. 2d. carried forward from last year, makes a total of £4,631 6s. 7d., out of which the directors recommend a similar dividend to that of last year, viz., 5 per cent., carrying forward £356 10s. 7d. During the year buildings have been erected on part of the new premises mentioned at our last meeting, at a cost of £2,028 8s. 9d. New plant has been provided for this and other portions of the works, at a total expense of £1,910 0s. 11d., and we have maintained existing buildings, plant, and tools, at a cost of £2,610 12s. 1d., so as to keep the whole of these in thoroughly good order. Notwithstanding the severe competition which now exists, I am pleased to tell you that there has been a very considerable increase in the amount of business transacted over that of any previous year, and the increased space at our works has enabled us to cope with the demand. Amongst the larger contracts we may mention extensions for Birkenhead and Liverpool Corporations, new works for the Leith, Gloucester and Colchester Corporations, and Morecambe Urban District Council. Since our last meeting we have received the Royal warrant of appointment as storage battery makers to Her Majesty the Queen. As you are doubtless aware, the obtaining of these warrants is a matter of considerable difficulty, and the E.P.S. Company is the first and only firm to which a Royal warrant has been granted for any electric appliance. Owing to the demand by engineers for a battery having an exceedingly high rate of discharge for traction and central station purposes, we have added a new type to our manufactures, consisting of specially heavy plates, so constructed and arranged as to be capable of being completely discharged in one hour. These cells, while combining the latest improvements of the E.P.S. plates, are designed on the type well known on the Continent, where it enters largely into the equipment of the principal electric light and power stations. While referring to this matter, I may mention that one in particular of our competitors is stated to be the only company that has had any experience in these heavy traction batteries. These statements probably arise from the fact that in this country there have been up to the last year or so but few electric power stations devoted wholly or even largely to tramway purposes, and consequently there has been no demand for this type of cell. But it is a fact that the methods of construction adopted by the largest accumulator manufacturers on the Continent were originally the outcome of the experience of this company and its immediate predecessors, and some of the foreign engineers came to our works at Millwall by agreement. Numbers of these batteries were manufactured under license from this company, and royalty on them was paid to us. We have already received large orders for this type, including one from the Liverpool Corporation for its tramway plant, and from the Metropolitan Electric Supply Company for one of their lighting stations. The chief development in traction during the past year has been the starting of a service of cabs by the London Electrical Cab Company, which cabs ply for hire in the streets, and carry passengers at the usual fares of horse vehicles. The whole of these are equipped with our Faure-King cells, and each cab carries a battery capable of taking it a distance of 50 miles without recharging. We have been unable to find any other storage battery at present manufactured commercially in this country or abroad from which a run of more than 30 miles can be obtained from the same weight and dimensions of battery as ours. The service, which was started in August of last year, has been continued successfully ever since, and we have at present in hand for this company large orders for extensions. The Compagnie Generale des Voitures in Paris and its allied company have ordered several sets of these Faure-King batteries for their electrical cabs, and they are at present running some four or five experimental vehicles with them, and with great success. With regard to improvements in secondary batteries and patents therefor, it has been the aim of the directors to ensure that this company shall always retain its premier position in the storage battery industry, and with this object every invention which is brought to its notice is fully investigated, and where samples can be made or obtained, they are carefully tested in the company's laboratory, and no trouble or expense is spared in order to thoroughly investigate the merits of each particular case. Whenever there is reason to believe that the company's manufactures would be improved by the adoption and use of an invention, it is our policy, wherever possible, to make such arrangements as to ensure the company obtaining the sole right for its use. In the early part of the present year, owing to failing health, Mr. Frank King was compelled to tender his resignation as manager of the company. I need hardly say the directors accepted this with great regret. In electing him to a seat on the board we have been able also to provide for his advice being obtainable on all points connected with the business of the company. It is a matter of considerable satisfaction to your directors that, notwithstanding the increase in price of raw materials, especially of our staple article of consumption, lead, they are able to recommend the same dividend as paid for the last six years, and for this they are indebted to the steadily increased output of the works and constant attention of the staff to economy in production. I now move the following resolution:—"That the directors' report and balance-sheet to May 31st, 1898, be and are hereby approved and adopted, and that a dividend of 5 per cent. on the paid-up capital be declared payable forthwith."

Sir JAMES PENDER seconded the resolution, which was adopted unanimously.

The election of Mr. King as a director having been confirmed, Sir James Pender, retiring director, was re-elected, and the proceedings terminated with a vote of thanks to the chairman for presiding.

Consolidated Telephone and Construction Company, Limited.

The meeting of this company was held yesterday at Winchester House. The directors' report and accounts, which we shall print next week, were unanimously adopted. Orders have been very scarce indeed, and the report asked the shareholders to consider what should be done in regard to the future of the company. Mr. FitzGerald presided, and addressed the meeting on the position of the company. After the report had been adopted it was arranged to call a meeting to be held in a month's time, to consider what steps shall be taken. The board will then come forward with a proposal. From the comments of several shareholders yesterday, there seemed to be a desire to continue the business in the hope of better times. We shall report the meeting fuller next week.

Eastern Telegraph Company.

The report of the directors of the Eastern Telegraph Company, Limited, for the half-year ended March 31st last, presented to the ordinary general meeting held in London yesterday states that the revenue for the period amounted to £472,734, from which is deducted £118,402 for the ordinary expenses, and £35,979 for expenditure relating to repairs and renewals of cables, &c., during the half-year. After providing for £2,306 for depreciation of spare cables, and £6,887 for income-tax, there remains a balance of £309,160, to which is added £41,904 brought from the preceding half-year, making a total available balance of £351,064. From this balance there has been paid—Interest on debentures and debenture stock £29,856, dividend on preference shares £20,296, an interim dividend of 2s. 6d. per share on the ordinary shares £50,000, bonus to staff £27,344, absorbing together £127,496, leaving a balance of £223,568, out of which the directors have placed £10,000 to the reserve fund for maintenance ships, £10,000 to the fire insurance fund, £10,000 to the land and buildings depreciation fund, and £60,000 to the general reserve fund. The directors now recommend the declaration of a final dividend for the year ended March 31st last of 2s. 6d. per share and a bonus of 4s. per share, amounting altogether to £130,000, both payable on 21st inst., free of income-tax, and making, with the three previous payments on account, a total distribution of 14s. per share, or 7 per cent. for the year on the ordinary shares. A balance of £3,568 is proposed to be carried forward. The revenue includes £35,863, dividends for the half-year upon the company's investments in other telegraph companies. The Royal Assent has now been given to the Eastern Telegraph Company's Act, 1898, promoted by the company in Parliament for the conversion of the 6 per cent. preference shares into 3½ per cent. preference stock, and for other purposes. The new certificates are ready for delivery, and those shareholders who have not already exchanged their share certificates for the new stock certificates should do so at as early a date as possible. The Stock Exchange has granted an official quotation for the new preference stock. The directors consider that it is now expedient to convert the ordinary shares into stock, and in accordance with Article 28 of the articles of association, the shareholders will be asked to sanction such conversion at an extraordinary meeting to be held immediately after the general meeting. In order to provide the capital required for additional cables from Porthcurnow to Gibraltar and from Gibraltar to Malta, and for other purposes, the directors have decided to issue a further amount of £500,000 3½ per cent. preference stock. In view of the necessity for additional office accommodation, incidental to the continued development of the company's business, the company, in conjunction with the other associated telegraph companies, have purchased the lease of a plot of land situated in Finsbury Pavement, with the object of erecting thereon a suitable building to provide for the present and probable future requirements of the whole of the associated telegraph companies.

The ordinary general half-yearly meeting of this company was held yesterday at Winchester House, the Marquis of Tweeddale in the chair.

After referring to the deaths of Mr. Stronge and Lord Sackville, the Chairman remarked that they had been able to obtain the services of Sir Henry Fischer as a director. The gross revenue amounted to £472,734, being a decrease of £7,088. Some of the decrease was undoubtedly due to the reduction of tariffs, but as more messages and more words were being sent they hoped in course of time to recoup themselves for those losses. The ordinary expenses for the half-year amounted to £118,402, an increase of £8,293, principally due to the increase in the staff. It would be seen from the accounts that their ships had been fully engaged effecting repairs. Cost of repairs this year had been abnormally high; the ships had been employed by other telegraph companies. Royal assent had been given to the Bill, which would enable them to convert the preference shares into stock. It had been decided to lay an additional cable between Porthcurnow and Gibraltar, and between Gibraltar and Malta, and between this latter place and Alexandria. After further remarks the chairman moved the adoption of the report, which was carried.

An extraordinary meeting then carried into effect proposals for converting shares into stock.

Monte Video Telephone Company.

An extraordinary general meeting of this company was held at Winchester House yesterday, to confirm a resolution passed at a meeting held on the 6th inst., to give powers to reduce and sub-divide the capital of the company. (The terms of re-arrangement of capital were published in the Electrical Review of July 8th, 1898.) On the proposal of the Chairman (Mr. Herbert Ward), seconded by Mr. Jones, the resolution was confirmed. Separate meetings were then held of the preferred and ordinary shareholders, when agreements made between the holders of the various stock and the company for instituting the changes in the capital were submitted and approved.

The Electric Construction Company.

The fifth annual meeting of the shareholders of this company was held yesterday at Winchester House, Old Broad Street.

Sir Daniel Cooper, Bart., who presided, moved the adoption of the report, and stated that, although the volume of the company's business during the year had increased, the profits had not increased in the same proportion. Still they had earned sufficient to pay the full preference dividend and one of 6 per cent. on the ordinary shares, in addition to adding something to the reserve fund. The company's position was steadily improving year by year, and he entertained the hope that the directors would be able to report a further improvement at the next annual meeting.

Sir Henry C. Mance seconded the motion, and the report was adopted.

The Brazilian Submarine Telegraph Company, Limited, and the Western and Brazilian Telegraph Company.

The directors' report to the extraordinary general meeting of the Brazilian Submarine Telegraph Company to be held at Winchester House on Wednesday, July 27th, at 12 noon, reads as follows:—

"The directors are glad to be able to announce to the shareholders that the negotiations for closer working between this company and the Western and Brazilian Telegraph Company, Limited, referred to in the recent half-yearly report, have been now brought to a satisfactory conclusion, and have resulted in agreements between the two companies, dated July 14th, 1898, the approval of which by the shareholders is invited at the extraordinary general meeting convened for Wednesday, July 27th inst., at noon, a notice for which accompanies this circular. Prints of these agreements can be seen at the company's offices. These two companies having been formed under the same auspices, and being bound together by joint purse agreements, it has long appeared to the board that a closer union would greatly promote their common interests, and tend to increased prosperity and increased stability if satisfactory terms could be arranged. After long and careful negotiation, the directors have been able to agree terms with the Western and Brazilian Telegraph Company, which they can recommend with confidence, and which they believe will meet with the hearty approval of the shareholders. To attain as far as possible complete unity of interest and of management, it is provided by the agreements to be submitted to the approaching meeting, that, immediately upon the approval of the agreements by the shareholders of this company, the London Platino-Brazilian Company, Limited, and the Western and Brazilian Telegraph Company, Limited, every shareholder of the Western and Brazilian Telegraph Company, Limited, and the Platino Company may exchange his shares for fully paid shares in the Brazilian Submarine Company upon the following basis, viz.:—

Shares in the Western Company to be transferred to the Brazilian Company.	Shares in the Brazilian Company, fully paid, to be given in exchange.
6 ordinary shares, £15 each ...	5 ordinary shares, £10 each.
6 preferred shares, and 6 deferred shares of £7 10s. each ...	5 ordinary shares, £10 each.
18 preferred shares, £7 10s. each	10 ordinary shares, £10 each.
18 deferred shares, £7 10s. each	5 ordinary shares, £10 each.
Shares in the London Platino-Brazilian Company, Limited.	
2 ordinary shares, £10 each ...	1 ordinary share, £10 each.

All amounts which, according to the above rates of exchange, would involve fractions of shares, will be arranged for by this company in cash on the basis of the market value for the time being of the shares of the Brazilian Company. To secure unity of management, it is arranged that directors from this company shall join the boards of the Western and Brazilian Telegraph Company and of the Platino Company, and that directors of the Western and Brazilian Telegraph Company shall join the board of this company, and that the united boards shall continue in office for five years. Some modifications in the articles of association will be required to enable these arrangements to be carried out, resolutions for effecting which will be submitted to the meeting as shown in the accompanying notice. The

agreement is conditional on members of the Western and Brazilian Telegraph Company holding at least three-fourths of the share capital, exchanging their shares for shares in this company."

The notice convening the meeting says that it is called for the purpose (*a*) of considering and, if thought fit, sanctioning an agreement, dated July 14th, 1898, and made between the Western and Brazilian Telegraph Company, Limited, of the first part, the London Platino-Brazilian Telegraph Company, Limited, of the second part, and the Brazilian Submarine Telegraph Company, Limited, of the third part; and an agreement dated July 14th, 1898, and made between the Brazilian Submarine Telegraph Company, Limited, of the first part, William Stratford Andrews of the second part, and the said William Stratford Andrews of the third part; (*b*) of considering and, if thought fit, passing the resolutions printed below. If the resolution numbered 2 be passed by the requisite majority, it will be submitted for confirmation as a special resolution to a second extraordinary meeting, which will be subsequently convened. Copies of the two agreements referred to may be seen at the offices of the company.

Resolutions.

1. That the capital of the company be increased by the creation of 120,000 new ordinary shares of £10 each, and that such of those shares as may be required, be issued and allotted at such times, to such persons or corporations, and in such manner as the board may deem expedient, for the purpose of giving effect to an agreement dated July 14th, 1898, and made between this company of the first part; William Stratford Andrews on behalf of all the shareholders of the Western and Brazilian Telegraph Company, Limited, ratifying that agreement of the second part, and the said William Stratford Andrews on behalf of all the shareholders of the London Platino-Brazilian Telegraph Company, Limited, ratifying that agreement of the third part, being an agreement with respect to allotment of shares in this company in exchange for shares in the said two other companies upon the terms therein mentioned, and that such agreement be, and the same is hereby sanctioned and confirmed.

2. That the articles of association of the company be altered in manner following:—

"(1) There shall be inserted after Article 80 the following Article, namely:—

"'Art. 80A.—The board may at any time in the year 1898 appoint such number of the directors of the Western and Brazilian Telegraph Company, Limited, to be directors of this company, as in the opinion of the board may be expedient for the purpose of giving effect to the provisions of the joint working agreement of July 14th, 1898, and (notwithstanding anything to the contrary contained in these presents) none of the existing directors of this company, or of the directors appointed under this Article, shall be liable to retire by rotation at any time during a period of five years from the date when the joint working agreement of 1898 shall have become absolute, in accordance with the provisions therein contained."

'(2) There shall be inserted in Article 92, after the word "present," the words "in person or by proxy," and there shall be added on to the end of the same Article the following clause, namely:—

"'A director may attend and vote in person or by proxy at any meeting of the board, but the proxy must himself be a director, and be appointed in writing under the hand of the appointor, in such manner as the board may require."

"(3) There shall be inserted after Article 99, the following Article, namely:—

"'Art. 99A.—An agreement (called in these presents "The joint working agreement of 1898") dated July 14th, 1898, and made between the Western and Brazilian Telegraph Company, Limited, of the first part, the London Platino-Brazilian Telegraph Company, Limited, of the second part, and this company of the third part, (being an agreement for the joint working of the undertakings of the said three companies upon the terms therein mentioned) shall be, and the same is hereby sanctioned and confirmed; and accordingly the board shall in the management of the business and affairs of this company act in such a manner as, in their opinion, may be necessary or expedient for the purpose of giving effect to the joint working agreement of 1898."

"There shall be added on to the end of Article 110 the following clause, namely:—

"'All remuneration under this article may be dealt with in such manner as, in the opinion of the board, may be expedient for the purpose of giving effect to the working agreement of 1898.'"

A similar circular has been issued to the shareholders in the Western and Brazilian Company, Limited, who will meet at the same time and place to pass the following resolution:—That the articles of association of the company be, and the same are hereby altered in manner following:—(1) There shall be inserted after Article 25, the following article, namely:—

"25A. When, and so soon as the joint working agreement of 1898 has become absolute in accordance with the provisions therein contained, the board shall appoint such number of the directors of the Brazilian Submarine Telegraph Company, Limited, to be directors of this company, as may be expedient for the purpose of giving effect to the provisions of the same agreement, but so that the number of the board shall not be thereby increased to more than 10, and (notwithstanding anything to the contrary contained in these presents), none of the existing directors of this company, or of the directors appointed under this article, shall be liable to retire by rotation during a period of five years from the date when the joint working agreement of 1898 shall have become absolute in accordance with the provisions therein contained."

(2) There shall be added on to the end of Article 29, the following clause, namely:—

"All remuneration under this article shall be dealt with in such manner as may be expedient for the purpose of giving effect to the joint working agreement of 1898."

(3) There shall be inserted after Article 42 the following Article, namely:—

"42A. An agreement (called in these presents the 'Joint Working Agreement of 1898') dated July 14th, 1898, and made between this company of the first part, the London Platino-Brazilian Telegraph Company, Limited, of the second part, and the Brazilian Submarine Telegraph Company, Limited, of the third part (being an agreement for the joint working of the undertakings of the said three companies upon the terms therein mentioned), shall be, and the same is hereby sanctioned and confirmed, and (notwithstanding anything to the contrary in these presents contained) the board shall from time to time do all such acts and things as may be necessary or expedient for the purpose of enabling the undertaking of this company to be worked in accordance with the Joint Working Agreement of 1898 or for the purpose of otherwise giving effect to such agreement."

Crompton & Co., Limited.

Mr. J. Trotter presided over the annual meeting of the shareholders of the above company, held yesterday at the Cannon Street Hotel, and in moving the adoption of the report, said that notwithstanding the strike at the works at Chelmsford and the removal, they had made a profit equal to 5 per cent. on the present capital. There was a growing activity in electrical matters, and he had no hesitation in saying that Cromptons would obtain a good share of the orders which would be given. Directly they had dealt with the loans from bankers in a satisfactory manner, they would consider about declaring a dividend, and at the present time they were considering the sale of the Chelmsford Electric Lighting Company to pay off the loans.

Mr. Crompton seconded the motion, which was carried.

City and South London Railway Company.

The report of the directors, with statement of accounts for the half-year ending June 30th, 1898, to be submitted to the half-yearly ordinary general meeting of the company, to be held at the offices of the company, 46, King William Street, in the City of London, on Tuesday, July 26th, 1898, at 12 o'clock noon, states that the receipts from all sources for the past half-year have amounted to £27,552 10s., and the cost of working has been £15,614 6s. 5d., leaving a profit of £11,938 3s. 7d. Inclusive of the balance brought forward from December 1st last, the net revenue account shows an aggregate total of £13,506 4s. 9d. After making provision for the debenture stock interest, a balance remains available for dividend of £10,498 2s. 8d. Out of this sum your directors recommend that the full dividend of 5 per cent. per annum be paid on the preference shares, and that a dividend at the rate of 2½ per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £1,035 9s. 3d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket-holders, carried since the opening of the railway in each half-year:—

Half-year ended	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).		
		£	s.	d.
December 31st, 1890 (11 days)...	165,000	1,568	3	9
June 30th, 1891	2,412,343	19,403	6	9
December 31st, 1891	2,749,055	19,798	16	6
June 30th, 1892	2,813,162	20,931	4	2
December 31st, 1892	3,117,602	22,002	17	5
June 30th, 1893	3,146,656	22,458	6	9
December 31st, 1893	3,093,351	22,067	14	10
June 30th, 1894	3,383,154	23,564	10	6
December 31st, 1894	3,275,649	23,540	12	4
June 30th, 1895	3,113,199	23,711	5	8
December 31st, 1895	3,172,438	23,780	3	7
June 30th, 1896	3,192,672	24,021	13	0
December 31st, 1896	3,368,480	25,456	6	9
June 30th, 1897...	3,437,810	26,403	3	6
December 31st, 1897	3,337,861	25,472	12	10
June 30th, 1898...	3,478,977	26,356	16	4
Total since the opening of the line	47,257,409	£350,537	14	8

Although the receipts from passenger traffic show no increase over the corresponding period last year, it is very satisfactory that they have been maintained in spite of the fine mild weather that prevailed during the first portion of the half-year, and that last year the receipts for the month of June were abnormally swollen by the heavy traffic occasioned by the Diamond Jubilee festivities. This result has been obtained by a steady increase of the mid-day and short distance traffic. The progress with the works of the extension to Moorgate Street has been continuous, and the tunnelling is rapidly approaching completion. The work of upholding St. Mary Woolnoth Church has been successfully carried out, and the large shaft for the lifts at this station is now being sunk. At Moorgate Street both station tunnels are completed, while at Lombard Street and Denman Street the construction of these tunnels is proceeding rapidly.

A contract on favourable terms has been entered into for the construction of the extension to Clapham Common. The sites for the stations having been acquired, the work has been commenced, and should be completed by the end of August, 1899. The property adjoining the depôt at Stockwell, referred to in the last report, has been purchased, and preparations are being made for the erection of the new engine and boiler house for the reception of the additional plant required for the working of the extension to Moorgate Street and Clapham Common, and the requisite engines and boilers have been ordered. Of the new locomotives required three are under contract, and several others are being constructed in the company's own works. Thirty additional carriages have also been ordered. The Bill promoted in the present session has received the Royal Assent. Its provisions, as explained at the special meeting in February last, were but slightly varied in its passage through Parliament. The City and Brixton Bill has also received the Royal Assent. At the conclusion of the ordinary business the meeting will be made special, in order to sanction the creation and issue of the additional capital authorised by the Act of the present session, and the exercise of the borrowing powers conferred under the same Act. The 22,500 ordinary shares offered to the proprietors in February last were all subscribed for and allotted. The 5 per cent. terminable debenture bonds have now all been paid off.

The Telegraph Manufacturing Company, Limited.

In another part of this issue will be found the prospectus of this well-known company, the list of applications closing on Wednesday next, July 27th. The registered share capital is £200,000, in 20,000 5 per cent. £5 preference shares, and 20,000 £5 ordinary. The Telegraph Manufacturing Company, Limited, incorporated in 1886, is the vendor, and that company and its nominees take 6,600 preference and 6,600 ordinary shares in part payment of the purchase money. The balance of both classes of shares are now offered to the public. The business to be purchased is well established, and seems to be in a very prosperous condition. Increased business has rendered additional capital necessary, and this will be provided by the present issue. The prospectus gives particulars of the valuation of the land, buildings, plant, machinery, &c., which is put down by Messrs. Fuller, Horsey, Sons & Cassell at £70,390. These figures are exclusive of goodwill, patents, and other items, as shown. The vendor will receive £160,000 for the business and everything complete as a going concern, £100,000 being paid in cash, and the balance in £33,000 worth of preference and £33,000 of ordinary shares. Three of the directors of the old company will be retained on the board of the new company, and among the various agreements mentioned is one under which the company retains the services of Dr. John Hopkinson as a director and consulting engineer for four years. We observe that in consideration of his consenting to act in such capacity, Dr. Hopkinson will receive in addition to his ordinary remuneration 250 preference and 250 ordinary shares. These will be paid by the vendor company from their purchase money. The accountants' certificate shows that the average profits for the past three years were £16,483. For the last of the three years it was over £20,000. This is sufficient to provide for depreciation, directors' fees, preference interest, and to leave an ample margin for a substantial dividend on the ordinary capital. We shall be surprised if the issue is not taken up very readily by the public.

Telegraph Construction and Maintenance Company.

The half-yearly general meeting of this company was held on Tuesday, Sir R. G. W. Herbert presiding.

The Chairman said that no accounts or resolutions were submitted, but, according to the usual custom, he would announce the interim dividend of 5 per cent. provided by the articles of association. The condition of the property, and of the work proceeding at both the factories, was satisfactory. Both the gutta-percha works and the cable factory were actively employed, and although the price of materials had been rising, and it was increasingly difficult every year to earn large profits, it was a matter for congratulation that their works should be fully employed. One interesting event which had occurred since they last met was the launching of their cable ship, the *Anglia*, which was the finest cable ship afloat, and was so constructed as to be able to be used for commercial purposes, and thus earn money when not being used on cable work.

Dublin United Tramways Company.

The report of the directors for the half-year ended June 30th states that the receipts amount to £23,365 13s., derived from the profits of the Dublin United Tramways Company and the Dublin Southern District Tramway Company, making, with the balance brought from last half-year, £24,288 11s. 6d. at credit of net revenue account. Deducting mortgages, debenture interest, and directors' fees, a sum of £22,409 2s. 4d. will remain available for division. Out of this sum the directors have declared a dividend at the rate of 6 per cent. per annum on the preference shares, and at the rate of 4 per cent. per annum on the ordinary shares, leaving a balance of £400 5s. 2d. Considerable progress has been made during the half-year with the conversion of the Dublin United Tramways into an electrical system, involving capital expenditure so far exceeding £100,000, of which very little is as yet reproductive. The working expenses by horse-power were 71·76 per cent. of the gross receipts, and by electric power 47·09 per cent.

The City of London Electric Lighting Company, Limited.—Return of gross revenue from supply of electricity only during quarter ended June 30th, 1898:—Gross revenue from public lighting, quarter ended June 30th, 1898, £3,176: corresponding quarter last year, £3,155. Gross revenue from private lighting, &c., less allowances to customers, quarter ended June 30th, £24,950; corresponding quarter last year, £23,001; total, quarter ended June 30th, £28,126; total, corresponding quarter last year, £26,156; increase, £1,970. (In making a comparison, it must be remembered that since the commencement of 1898 the reduced charges of 7d. per unit, with a sliding scale reduction down to 4d. per unit for lighting, and 4d. and 3d. per unit for motive power, have been in force.) Equivalent of 8-C.P. lamps connected on June 29th, 1898, 321,700; increase during quarter, 11,040. Equivalent of 8-C.P. lamps connected on June 30th, 1897, 270,898; increase during corresponding quarter last year, 9,962.

The Edison and Swan United Electric Light Company, Limited.—After considering the accounts for the year ending June 30th, 1898, the directors have determined to recommend the payment of a dividend in respect of the six months ending June 30th, 1898, at the rate of 7 per cent. per annum, on the "A" share capital of the company as now paid up, carrying forward about £11,500, as against £8,493 7s. 6d. in the previous year. The above distribution, together with the interim dividend at the rate of 5 per cent. per annum, already paid in February in respect of the first half-year, will be equal to a dividend of 6 per cent. for the entire year. The dividend warrants will be posted on August 12th, 1898, upon the register as it stood on 19th inst.

Anglo-American Telegraph Company, Limited.—The directors of the Anglo-American Telegraph Company, Limited, have resolved, after placing the sum of £6,000 to the credit of the renewal fund, to declare an interim dividend for the quarter ending June 30th, 1898, of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, less income-tax, payable on August 2nd to the stockholders registered on the books of the company on July 11th, 1898. After paying the foregoing dividends there will be a balance of about £17,580 to be carried forward to the next account.

Bright's Light and Power, Limited.—The prospectus of this company is before the public, and the list will close on Monday. The present issue is of £50,000 5 per cent. debentures, £50,000 preference, and £66,667 ordinary. The company will take over the Santiago del Estero electric light works as a going concern, the Salta electric light works, and power and grinding mills, also other concessions of a similar nature.

Stock Exchange Notices.—The Committee has been asked to allow the following to be quoted in the official list:—City of London Electric Lighting Company, Limited—10,000 ordinary shares of £10 each, fully paid, Nos. 90,001 to 100,000, in lieu of the provisional certificates now quoted.

County of London and Brush Provincial Electric Lighting Company.—The directors have declared an interim dividend on the preference shares for the half-year ended June 30th at the rate of 6 per cent. per annum, less income-tax.

Globe Telegraph and Trust.—The directors recommend a final dividend of 4s. 3d. per share, making a total of 5½ per cent. for the year ending July 18th, and carrying over £2,000.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 16th, 1898, were £3,126 1s. 1d.; corresponding period 1897, £2,804 8s. 9d.; increase, £321 12s. 4d.

The City and South London Railway Company.—The receipts for the week ending July 17th, 1898, were £927; week ending July 18th, 1897, £844; increase, £83; total receipts for half-year, 1898, £2,828; corresponding period, 1897, £2,777; increase, £51.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 16th, 1898, were £226 0s. 7d.; total receipts to July 16th, 1898, £3,630 18s. 6d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for the week ending July 15th, 1898, were £1,077 4s. 8d.; corresponding week last year, £918 16s. 7d.; increase, £158 8s. 1d.; passengers carried, 153,625; corresponding week last year, 126,550; aggregate to date, £1,997 1s. 3d.; aggregate to date last year, £1,735 19s. 9d.; increase to date, £261 1s. 6d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 17th, 1898, amounted to £1,691; corresponding week last year, £1,506; increase, £185.

The Western and Brasilian Telegraph Company, Limited.—The receipts for the week ending July 15th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £2,561.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, July 13th.	Closing Quotation, July 20th.	Business done during week ended July 20th, 1898. Highest.	Lowest.
137,400*l*	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	99 —103	99 —103	101	...
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
923,960*l*	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	64 — 67	...	...
3,038,020*l*	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	116 —117	116 —117	117	116
3,038,020*l*	Do. do. Deferred...	Stock	...	...	...	16¼— 16¾	15½— 16	16 9/16	15⅝
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15½— 16	15¾— 16¼	16	...
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105	104
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	6½— 7½	7 — 8	7⅞	7
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½— 15½	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000*l*	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	102 —105%	102—105%	...	...
60,710*l*	Direct United States Cable	20	2½ %	2½ %	...	10¾— 11¼	11 — 11½	11¼	11 1/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100—103	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	7 %	17¼— 17¾	17¼— 17¾	17¾	17⅜
70,000	Do. 6 % Cum. Pref.	10	6	6	6	... ...	... ...	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	5 %	101 —104	101 —104	...	...
1,302,615*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	123 —127	123 —127	123½	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½— 18	17¼— 17⅝xd	17⅝	17⅜
25,200*l*	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	98 —102	98 —102	...	...
100,500*l*	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	99 —102	99 —102	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	124 —128	124 —128	124¾	...
35,100*l*	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	98 —103	98 —103	...	...
46,500*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	99 —102	99 —102	...	...
300,000*l*	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	102 —105	102 —105	...	...
200,000*l*	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	4½ %	11½— 12	11½— 12	12	11 11/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½— 17	16½— 17	17	16⅝
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	29 — 30	29 — 30	29½	29⅜
160,000*l*	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	101 —104	102 —105	...	...
97,000	Halifax & Bermuda Cable, 4½ % 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	50 — 53	50 — 53	53	...
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs. ...	100	6 %	6 %	6 %	108 —111	108 —111	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ...	5	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5½— 5⅝	5⅝— 5¾	5 13/16	5⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 9/16	5½
1,329,471*l*	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100—105	100—105	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	104 —107	104 —107	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	8¼	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4½— 5	4½— 4⅝xd	4½	...
146,733*l*	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	103 —106	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
213,400*l*	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	101	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	11½— 12	12½— 13	12¾	11 9/16
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7½— 8	8½— 9	8¾	7⅞
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	1/16 %	4½— 4¾	4 — 4½	4 3/16	4
889,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	3/8 %	1 %	3/8 %	½— ¾	½— ¾	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	7¾— 8¼	8 — 8½	8 1/16	8
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —107	104 —107	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —110	105 —110	...	...
160,100*l*	Do. do. do. 6 % Ster. Bonds ...	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11 — 12	12½— 13	13⅜	13
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5¾— 6¼	5¾— 6¼	6	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277...	5	5 %	5 %	6 %	8 — 9	9 — 10	10¼	8⅝
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	25 — 26	26 — 27 xd	27 7/16	26½
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ...	10	...	...	...	25 — 26	26 — 27 xd	26½	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	16½— 17½xd	16½	16½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	125 —130	125 — 130	128	126½
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	12½— 13½	13½— 14½	14½	14
10,000	Do. do. do. Nos. 30,001 to 40,000 £6 paid.	10	...	...	...	8 — 9	9½— 10½	10	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½xd	15	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400 £6 paid	5	...	...	...	3½— 4½	3½— 4½xd	4½	4½
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	8 — 9	9½— 10½	10¼	9½
10,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15 — 16	17½— 18½	19¼	17¾
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	116 —120	116 —120	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	14½— 15½	16½— 17½xd	17¼	16¾
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7¼ %	10½ %	14½ %	15½— 16½	17 — 18	17¾	15¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108	105 —108	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	1¾— 2¼	2¾— 3¼	3½	3⅛
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	15 — 16	15½— 16½	17¼	15¼

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation July 13th.	Closing Quotation July 20th.	Business done during week ended July 20th, 1898. Highest.	Lowest.
30,000	British Electric Traction	10	...	...	...	16½— 17	16½— 17	16½	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £7 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	10½— 11	10½— 11	10⅞	10 13/16
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅞— 2	1⅞— 2⅛	2	1 15/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2 — 2¼	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	100 —103	102—105	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	9⅞— 10¼	9⅞— 10¼	10⅜	10
129,179	Do. do. do. £6 paid	10	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	1 1/16	...
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 3/16%	1 1/16%	1⅛%	69 — 71	68 — 71	70½	69¾
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd.	10	...	...	...	2⅜— 3¼	2⅜— 3¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	89 — 94	89 — 94	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅓%	6 %	2¼— 2⅜	2¼— 2⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅓%	6 %	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103	101 —103	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2⅛— 2¼	2⅛— 2¼	...	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	3⅛— 3⅜	3⅛— 3⅜	3¼	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	107 —109	105 —107xd	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	3/8— 5/8	3/8— 5/8	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	8 — 10	8 — 10	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	21½— 22½	21½— 22½	22½	21½
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	19½	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½xd	22	21½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	3¼%	10⅜— 10½	10⅜— 10½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅜— 16½	15⅜— 16½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 39	36 — 39	38	37½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	100 —103	100 —103xd	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	119 —124	116 —121	120	117

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛xd.

House-to-House, 4½% Debentures of £100, 106—109.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—14; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 106—108. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3½—4.

*T. Parker, £10 (fully paid), 14½xd.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8¼—8¾. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 2½ per cent. (June 30th, 1898).

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1898.

THE USE OF ACCUMULATORS IN CONNECTION WITH LIGHTING AND TRACTION SYSTEMS.

By JOHN H. RIDER, Borough Electrical Engineer, Plymouth.

ACCUMULATORS have always been an essential part of the equipment of a continuous current lighting station, and their value is becoming more recognised every day in alternating current and power stations. In order, therefore, that the opinions and experiences of members may be obtained, this paper is presented with the hope that it may give rise to a useful discussion.

The efficiency of accumulators $\left(\frac{\text{watts output}}{\text{watts input}}\right)$ will seldom exceed 75 per cent. under ordinary working conditions, and since a steam plant must always be used to charge them, it follows that a given output can generally be obtained more cheaply directly from the steam plant, *if it can be run at an economical load*, than from accumulators.

But in deciding what is an economical load for any given set of steam plant, the whole of the plant—boilers and piping, as well as engines and dynamos—must be taken into account. By proper subdivision of the dynamo units, it will generally be found possible to keep the running sets at a fairly economical load, But with the boilers and piping it is different. Steam has practically to be kept up for the whole of the 24 hours in as many boilers as will be required at the maximum load, and the whole of the steam piping kept connected ready for use. So that at, say, anything under three-quarters of the maximum load, the steam plant is generally working uneconomically, because of the large "stand-by" and radiating losses. Therefore it would pay to run one of the dynamos, if necessary, for the sole purpose of charging accumulators, when the load on plant as a whole had dropped to an uneconomical point. Or if a dynamo has to run in order to supply electricity for other purposes, and it can only be run under such conditions at a low load-factor, then it would pay to use its surplus power for charging cells.

The discharge from the cells can, in like manner, be economically used at any time when either a dynamo would otherwise have to run lightly loaded, as, for example, when the load on the station was more than x dynamos could do, but considerably under the output of $x + i$ dynamos, or, when the gain in efficiency by using the steam plant direct would be more than counterbalanced by the extra number of men required to work it. Or when, by taking a share of the load at the "peak," the total amount of the plant at the station may be reduced.

It may be therefore stated, as a general rule, that it will pay to use accumulators in a station, if they can be both charged and discharged at a time when the steam plant, or part of the steam plant, would otherwise be working at an uneconomical load.

It is practically impossible, in any station, so to arrange matters that all the plant working shall be kept at an economical load for any length of time. The demand is constantly varying, and oftentimes in a most unexpected manner. So that in almost every station a set of accumulators would be of service, the cells being used to level the load on the plant. We all want our "load curve" to be a horizontal line, and accumulators will help us to obtain this by filling up the hollows with a charge, and by levelling the peaks with a discharge.

Accumulators are of far more value in a station when used in this way, than when kept for the purpose of acting as a stand-by, in the event of a failure of any of the plant. Of course, when charged, they are always available for this, up to the limit of their output, but primarily their use should be to supplement the plant, by helping it to work at an economical load.

The prime cost of a battery for a given kw. output (for five hours), is roughly the same as for steam dynamos and boilers for the same output. The depreciation need not be more than 5 per cent. per annum, if properly treated and looked after, and this is about the same as for the steam plant.

We will briefly consider the use of accumulators in (1) the continuous current lighting station, (2) the alternating current lighting station, (3) the traction station, and (4) the combined lighting and traction station.

CONTINUOUS CURRENT LIGHTING STATIONS.

Continuous current lighting stations are now almost universally on the multiple-wire system, with either three or five distributors, and

the battery is therefore divided into equal sections, the whole being, however, in one series. Fig. 1 shows an arrangement which is in use at a number of stations in this country.

It will be noticed that only two of the dynamos are connected with the middle wire. The others (generally of a larger size) are connected directly across the outers. Even though the accumulators may be large enough to take the difference in load between the two sides of

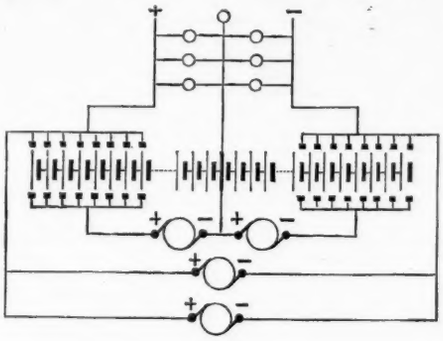


FIG. 1.

the system, when the larger dynamos are running, it is not possible, or at any rate advisable, to connect all the machines directly to the outers, because the two sides of the battery may be discharged unequally, and it is therefore necessary to be able to charge them at different rates.

The larger machines need only give a voltage equal to that required on the feeders at the highest load. The two smaller ones must be able to give together a voltage at least 25 per cent. higher than this, in order to properly charge the cells. As is well known, the voltage of a cell remains sensibly constant during discharge, but during charge the back E.M.F. gradually rises, owing to the chemical action and the formation of gases. This is shown in fig. 2.

One result of this rise of pressure at the terminals of the cells, is that the battery must either be entirely cut off from the lighting circuit during charging, or else regulating switches must be used, so that the number of cells connected to the mains may be varied, and

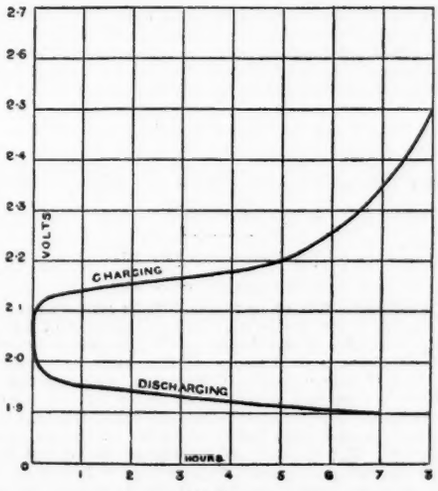


FIG. 2.

the pressure on the lighting circuit kept constant. And as the number of cells connected to the lighting circuit must be altered, so also must regulating switches be provided to vary the number of cells connected to the charging dynamos, in order that the end cells may be equally charged with the rest. These regulating switches are indicated in fig. 1. It is extremely important to watch that the charging switches are never connected to a less number of cells than the discharging switches, or else the intermediate cells will be liable to be charged in the reverse direction.

It will be found practically impossible to prevent unequal charging and discharging of the end cells, particularly if there be any load on the mains while the charging is going on. Nothing is more liable to upset a battery as a whole, than to have any cells unequally charged with the rest. Even at a little sacrifice of efficiency the battery should, so far as possible, be charged and discharged as a whole, in order that every cell may be equally treated. This is hardly possible by the arrangement shown in fig. 1. Unequal use of the cells leads to unequal capacities, with the liability to reversals, and all its consequent troubles.

For these reasons the arrangement shown in fig. 3 is much to be preferred.

All the dynamos are connected directly across the outers, the two smaller ones having a middle wire connection as well. There are no regulating switches required at all, except when the battery is being discharged. The dynamos at all times give the voltage required on the bus bars, and there is no need whatever to vary their pressure on account of the charging of the cells. The extra voltage required for the charging is added to the voltage of the bus bars by means of a small "booster" in the cell charging circuit, and the rate of charge can be varied to any extent simply by varying its excitation. The boosters can be carried on extensions of the shafts of the smaller units, as indicated in fig. 3, or may be motor driven if desired.

Each side of the battery may thus be charged and discharged as a whole, and when discharging its pressure, is varied by means of back E.M.F. cells as indicated.

A sign of the times is the tendency to favourably consider the use of accumulators in sub-stations. They should be charged directly from the mains during periods of light loads, the extra voltage being obtained by means of motor-driven boosters. Not only the station plant, but also some of the mains may, by this means, be kept economically loaded.

ALTERNATING CURRENT LIGHTING STATIONS.

Contrary to the general practice of engineers who have to use alternating current plant, the writer has for many years advocated the use of accumulators in such stations. Their uses are two-fold. They can be used as a stand-by for the exciting plant, and also, particularly in small stations, to keep up the supply during the hours of

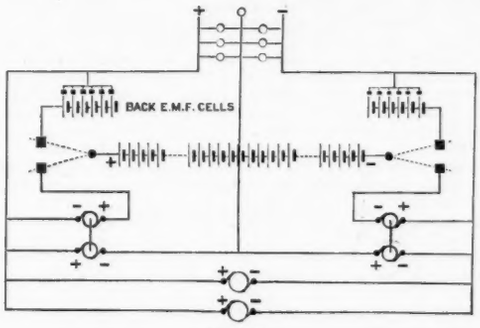


FIG. 3.

light load, through the medium of a motor-alternator. The day load plant could conveniently consist of an engine, alternator, and dynamo on the same shaft, with a clutch coupling between the engine and the machines, as in fig. 4.

The alternator and dynamo should each be of the same output, and the engine sufficient to drive either at full load or both at half load. During the daytime the engine would drive both, the alternator for whatever lighting there may be on the mains, and the dynamo for charging the cells. As the lighting load increased, so the charging current would be decreased, keeping the load on the engine constant. When it was desired to use the discharge from the cells, the engine would be uncoupled, and the dynamo run as a motor, driving the

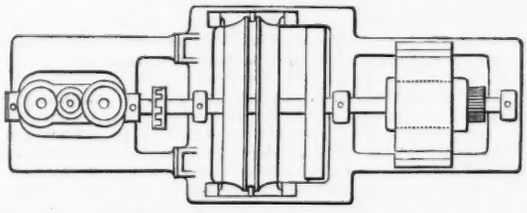


FIG. 4.

alternator. This may be done either at the time of the "peak" of the load, thus reducing the demand upon the boilers, or at any time when there was only a small load on the station, such as after midnight, or on Sunday mornings, so that a number of the staff may be relieved.

If the alternator be excited from bus bars, fed by a common exciter, or exciters, the cells would be joined in parallel with them, and the charging dynamo would take the place of all or some of the exciters.

If each alternator have a separate exciter, then change-over switches should be provided, so that the cells may be used on any machine when required, instead of its own exciter.

TRACTION STATIONS.

Accumulators have earned for themselves a bad name in connection with traction systems, because they have in most cases been carried upon the cars, each set having only its own car to propel. The result of this has been not only large cost in handling, owing to the removal of the discharged cells *en bloc*, and the substitution of a freshly-charged set every few hours, but also rapid deterioration consequent upon the shaking, and the heavy electrical strains due to frequently starting the cars.

With only one car to run, each set of cells has to be large enough for the maximum current taken at any time by that car, the average working current being probably not more than one-third the maximum. But when a number of cars are run from one battery, fixed either in the generating station or in a sub-station, a far less jerky load curve is obtained. Owing to the improbability of all the cars starting together, the maximum output is much lower in proportion to the average output, and the strains on the cells are much reduced.

Large transformers in sub-stations are much more efficient, and with a given capacity in kilowatts will allow of a much larger lamp connection than a number of small house transformers. In a similar way large batteries in stations or sub-stations are much more efficient, and with a given output will maintain a much larger car service than if divided amongst a number of cars.

Owing to the rapidly fluctuating load the plant in a traction station is generally working only at a low average load factor. The machinery running must be capable of meeting the maximum demand, while the average load does not probably exceed one-half of the maximum. The advantages of accumulators are most apparent here, and the wonder is that more traction stations do not use them.

(To be continued.)

PARLIAMENTARY.

London United Tramways Company.

On Thursday, last week, the Bill promoted by the London United Tramways Company "for affording further powers for constructing tramways and widening roads, and for using mechanical power on their tramways," came before the Select Committee of the House of Lords, presided over by Lord Ribblesdale. Under the Bill power is sought for the extension of the company's existing lines from Kew Bridge to Hounslow, through Brentford along the Chiswick High Road, and from Brentford along the Boston Road to Hanwell, and for the application of electricity throughout the whole system.

Mr. Littler, Q.C., Mr. Balfour Browne, Q.C., Mr. Lewis Coward, and Dr. Bernard O'Connor, represented the promoters, and Mr. J. C. Earle the Middlesex County Council, who put forward the only opposition to the Bill as amended by the House of Commons Committee.

Mr. Coward, in opening the case, explained in detail the objects of the Bill, and said the only question between him and his friend turned upon the agreements which had been made with the local authorities. In the course of negotiations before the Bill was deposited, and during its conduct through the other House, certain agreements had been come to between the promoters of the local authorities through whose districts the line was to be constructed, and in some cases it was agreed that payments or contributions should be made to the local authorities in respect of the roads and the maintenance and repair thereof. With regard to two of the local authorities, the agreements that had been entered into had been struck out of the Bill by a Committee of the House of Commons, and there was one agreement now remaining, viz., that with the Chiswick Urban District Council. The actual terms of the agreement were to pay to the Council £350 per annum, commencing from the passing of the Act, for five years after; £500 per annum for seven years, and then £750 per annum, until the expiry of a term of 21 years from the passing of the Act. The consideration for that payment was, that the local authority should defer exercising the power of purchasing part of the undertaking from 1903 to 1919. He understood that the Chairman of Committees had allowed the agreement with Chiswick to stand, on the ground that the extension of the line was a good consideration for the sums which the company bound themselves to pay to the District Council. From the petition it appeared that the Middlesex County Council took the view that the agreement which ensured benefits to the Chiswick Council, should be participated in by the Middlesex County Council, but the promoters naturally wanted to keep faith with the Urban District Council of Chiswick.

Mr. J. Clifton Robinson, managing director and engineer to the London United Tramways Company, gave evidence in support of the scheme.

Mr. Earle, on behalf of the Middlesex County Council, argued that the agreements with Acton and Hanwell for the payment of certain sums to them by the Tramways Company if they were really completed still existed, and their exclusion from the Bill did not affect their validity. Although the local authority claimed to be the road authority, the Middlesex County Council were obliged, on the certificate of their surveyor, to bear the whole cost of maintaining and repairing the main roads upon which the proposed tramways were to run, and therefore the sums in question should be handed over to the County Council. It was evident that these payments were used by the Tramways Company as a means of overcoming the opposition of local authorities, and that was a thing which should be put a stop to.

The Committee passed the preamble, and decided that any contribution received by the local authorities from the tramway company should be handed over to the Middlesex County Council, but that in the case of Chiswick an apportionment should be agreed between the District Council and the County Council.

Unopposed Bills.

On Friday a number of Bills came before the Examiner, who decided that the Standing Orders had been complied with, and ordered the Bills for second reading. Amongst the Bills were the following:—

An Act to empower the Chelsea Electricity Supply Company to acquire lands and erect generating stations, and for other purposes.

The General Power Distributing Bill, which had already passed the House of Lords.

St. Helen's Corporation Bill, authorising the Corporation to construct tramways in and near the borough of St. Helen's, and for other purposes. The Act gives the Corporation power to construct, maintain, and use dynamos and other electrical apparatus, and to construct a station for generating electrical power, and either in connection with or separate from their electric light works, use dynamos, &c., for the generation of electricity.

An Act to confirm certain provisional orders made by the Board of Trade under the Electric Lighting Acts of 1882 and 1888, authorising the Chelmsford Electric Lighting Company to supply public and private light within the parishes of Writtle, Great Baddow, Broomfield, Springfield, and Widford, in the rural district of Chelmsford.

To confirm the order of the Melton Mowbray Electric Lighting Company in respect of the urban district of Melton Mowbray and a portion of the rural district of Melton Mowbray, both in the county of Leicester.

Norwich (Extension) Electric Light.—Provisional order granted to the Norwich Electricity Company.

Preston (Extension).—National Electric Supply Company, Limited. Provisional order in respect to the whole of the district of the Fulwood Urban District Council and part of the district of the Preston Rural District Council.

Provisional order to the Corporation of Warrington to supply within the borough of Warrington.

Confirming the provisional order granted by the Board of Trade under the Electric Lighting Acts to the County of London and Brush Provincial Electric Lighting Company, Limited, in respect to a portion of the district of the Holborn District Board of Works and the district of the St. Giles's Board of Works and the extra parochial places of Lincoln's Inn, Gray's Inn, Staple Inn, and Furnival's Inn.

Confirming provisional order made to the Bolton Corporation for the borough of Bolton.

To confirm the Kingswinford provisional order granted to the Rural District Council of Kingswinford, in the county of Stafford, in respect of the rural district of Kingswinford.

Confirming provisional order granted to the Penarth Electric Lighting Company in respect to the urban district of Penarth, in the county of Glamorgan.

Prescot (Extension).—Confirms provisional order granted to the British Insulated Wire Company, Limited, in respect of the District of the Huyton-with-Roby Urban District Council in the county of Lancaster, and for the purpose of amending the Prescot Electric Lighting Order, 1895, with respect to the undertakers under that order.

Confirming the provisional order of the Shrewsbury Corporation in respect to the borough.

Tramways Order Confirmation.—Confirming order authorising the General Electric Tramways Company, Limited, to construct additional tramways in the borough of West Hartlepool.

ELECTRIC LIGHTING PROVISIONAL ORDERS.

(Continued from page 79.)

The Marylebone Order.

The Committee on this order resumed their inquiry on Thursday, July 14th, when Mr. Brooke-Hitching, chairman of the Electric Lighting Committee of the Vestry, was further cross-examined. In reply to Mr. Fitzgerald, Q.C., one of the counsel representing the Metropolitan Electric Supply Corporation, the opponents of the order, the Witness said he was quite aware that in cases such as Bath, Liverpool, and Leeds, where the municipal authority had come in after a provisional order had been granted, they had bought out the company. He, himself, had advocated that course as far as regarded the City of London. The company, in June last year, gave notice to their consumers that the price would be reduced to 6d., as from January 1st of this year. At that time the order might not have been mentioned in the Vestry; but the question had been agitated in the parish for two or three years. His own view was, that in the event of the Vestry getting the order they should supply the light at a reasonable price, and, if possible, devote any profits they might make to the improvement of the parish, either by lighting, or, perhaps, in the relief of rates. They would supply the light under the Brighton scale, by which the charge was reduced after the first hour. The first initial outlay under the scheme would be some £76,000, and possibly the Vestry might have no objection to the expenditure of a quarter of a million if they thought it would be profitable. It was advantageous to a parish to have two companies working in the same area, because in the event of a temporary breakdown of one system, the other company would come and render assistance, provided that they worked on amicable terms.

Re-examined by Mr. Wobsley Taylor, Q.C., Mr. Brooke-Hitching said the Vestry were unanimous in applying for the order. They had 61 miles of streets in the parish, and only about one-eighth of a mile of them were electrically lighted, and if they obtained their order he considered they would be able to make a great increase in public lighting with advantage to the inhabitants. The Committee had never obstructed the company in their just demands as regarded the laying of mains, &c.,—on the contrary, they were prepared to assist them.

Mr. J. E. Waller, M.I C.E., member of the firm of Kincaid, Waller & Manville, in reply to Mr. Taylor, said that his firm had advised the Electric Lighting Committee of the Marylebone Vestry in regard to the provisional order they were now seeking to obtain. The area of Marylebone was one in which he should say there was ample room for two competing companies to work side by side. Two companies thought it worth their while to apply for powers to get into the area. There was not the slightest reason why the existing company should not participate in the development which would undoubtedly take place if the Vestry lighted all the streets by electricity. The Vestry would not compete unfairly with a company, because they were subject to certain charges which a company was not. For instance, they were under obligation to repay the whole of their capital within a certain number of years. There would be a large field for the operations of the Vestry without in any way trenching upon the business of the company. He did not see any reason why the Vestry should go below the ordinary market value in supplying the light to the public for private purposes, but he thought they might light the streets under cost price. The Vestry would be able to utilise their refuse for the purpose of obtaining their light. He was told that the Vestry paid £30 a year to the company for each of the six street lamps in Regent Street, but he should say that the Vestry would be able to supply at a much lower figure than that—probably £20 or less.

In cross-examination, the Witness said he was surprised to hear that the actual charge of the Metropolitan Company for their public lighting worked out at 1½d. per unit. Hampstead Vestry charged 3·80d., Islington 4·65d., and St. Pancras 4·25d. for their public lighting.

Mr. Balfour Browne addressed the Committee on behalf of the opposing company, and pointed out that the question was most important and far-reaching, for they were asked to sanction an absolutely new principle in legislation. A serious attack was made on capital just when it should be the aim of Parliament to induce capital to remain in the country. The result of the Vestry's application was that the shares of the company had gone from £21 to £14. He joined issue with the Vestry when they contended that the right of competition was expressly reserved for the local authority. He contended that the Board of Trade considered that there should be no competition by the local authority until after 42 years. In all cases of gas and water, the company was fully compensated before there was any competition by local authorities, and if that was good for gas and water, it should be good for electric light undertakings. The total capital of the company was £782,500, involved for 42 years over the whole of their districts. In Marylebone alone they had spent £219,733, and to say that should be rendered of no value by the competition of the local authority was contrary to all precedent. With regard to electricity, that was the first time he had ever heard of competition by a local authority. In 1896 there was a company in Bath supplying electricity under a seven years' license. Both the company and the local authority applied for provisional orders, but Parliament made them purchase the company, while only that year an application by the Leamington Corporation was thrown out, because they could not agree upon a purchase clause. The Vestry could ruin the company, and Parliament so far had never allowed confiscation.

Sir John Lubbock, M.P., said that in 1882 he was chairman of the Edison & Swan Company, and discussed with the Board of Trade the question of the length of electric light orders. He pointed out that the 21 years at that time was not sufficiently long to induce capitalists to go in for electric undertakings. He considered that it meant 21 years for certain. The Act of 1888 extending the period to 42 years caused a great spurt in electric lighting undertakings. Under that order the Metropolitan Company obtained the Marylebone area, and it was considered that the agreement with the Vestry was a security for the investors' money. He certainly considered that the agreement guaranteed the company for the 42 years, and he considered the competition of the local authority would be unfair.

Mr. Walter Gosden, manager of the Langham Hotel, spoke in satisfactory terms of the light supplied by the company. Their light came to between £1,200 and £1,300 a year.

The Committee adjourned.

Marylebone Provisional Order.

The Committee of the House of Commons resumed their hearing of the application of the Marylebone Vestry for a provisional lighting order on Friday.

Mr. Frank Bailey, managing director of the Metropolitan Electric Supply Company, was called, and stated that the company had expended £319,735 in Marylebone, and had 41 miles of conduits and 122 miles of cables. Their average dividend had been 2¾ per cent. They had met every demand made upon them, and it was not fair that the Vestry should come in and compete. The company was in a position to supply the whole of the district. They were capable of supplying both a continuous and alternating current, and that did away with any necessity for allowing another company to come in.

By the Chairman: The continuous current would require a different set of mains, and they had given notice of intention to lay such mains.

Continuing, Witness said they had never had any difficulty in laying mains till just lately with the Marylebone Vestry.

Mr. Robert Hammond, consulting engineer to numerous local authorities, gave evidence against the order, and said he did not consider that a local authority should come into an area and compete with an existing company, unless they purchased the undertaking.

Mr. Worsley Taylor, Q.C., in replying upon the application for the Vestry, said that the real and avowed object of the company in opposing the granting of the order was that they might have a monopoly. There was no doubt that if the order was refused to the Vestry, another company would come in, and then instead of there being competition there would be combination. The Vestry had a statutory right to introduce competition either by themselves or another company, and the company were perfectly aware of that at the time they received their provisional order. There was, he believed, room for the Vestry without trenching in any way upon the interests of the company; there would only be fair mercantile competition between them.

After conferring together in private, the Chairman announced that in the case of the Marylebone order they found that the provisional order should not be confirmed.

Decision in the Bermondsey Application.

After the conclusion of the Marylebone case the Chairman said. In the Bermondsey case we suggest that the order should be withdrawn, as the point raised in it is not, in our opinion, ripe for discussion. We are of opinion that the local authority should consider the question in the light of purchase. We think that if by an original order, or by purchase, any local authority becomes the sole power for electric lighting in its district, it should not be interfered with by competition from the granting of a provisional order to any company in such district.

Mr. Littler, Q.C., said the position had not been discussed in the light of the decision, and he would have liked time to have considered it.

The Chairman said they had suggested a course for the future, and had put them perhaps in a better position by offering an alternative. They were prepared to decide.

Mr. Littler said there were some cases where it would be better to go downstairs than be kicked down. If the Chairman would allow the order to proceed, they would accept a clause that they would take no steps till they had purchased so much of the undertaking as was within their boundaries, either by agreement or arbitration.

After further discussion the Chairman said the Committee would meet again on Thursday to consider the point raised.

THE TELEPHONE INQUIRY.

(*Continued from page* 103.)

The Select Committee on Telephones resumed its inquiry on Friday last, Mr. Hanbury presiding.

Mr. J. S. Forbes, replying to the Chairman, said he was the Chairman of the National Telephone Company.

The Chairman: What we particularly wish to get from you, Mr. Forbes, is information as to the precise *locus standi* of the company before this committee, and, first, as to the legal position of the Post Office with regard to competing with you in existing areas. You recollect the Treasury Minute of 1892, which distinctly stated that, should hereafter licenses be granted on other principles, no company now or hereafter to be licensed would have any grounds of complaint as to want of faith on the part of the Department?—Yes.

The agreement strictly provided for competition?—Yes, but with qualifications.

What are they?—We should not have consented to give up our position if a condition of that sort were to be taken too literally. Before we did consent to the agreement I had conferences with the Chancellor of the Exchequer (Mr. Goschen), the Postmaster-General (Sir J. Fergusson), and with his successor, Mr. Arnold Morley. Of course, their difficulty was that it was not competent for the Government to abrogate their absolute powers in a matter of this sort. But the result of the conference was that promises were given to me by Mr. Goschen, Sir James Fergusson, and later, by Mr. Arnold Morley, that this condition would not be taken too literally.

You had a verbal promise from Mr. Goschen?—Yes.

Can you give us a little more precisely what that verbal promise was?—I called his attention to the qualifications in his speech in the House of Commons on Dr. Cameron's motion. There were in that speech certain qualifications, and certain indications of what the Government would do in certain events arising. He specifically put forward that, as regards the Telephone Company, if they were not in a place, or, if, being in a place, they conducted the business so badly that they ought to be ousted, they might be ousted, and the Postmaster-General, either by himself or by a new licensee, might take up a competitive position. Those are not the precise words, but that is what I understood by it. I asked what I was to infer from that, and I was told that so long as we conducted the business reasonably well we were not to be ousted in favour either of the Post Office or of other people.

There was a clause reserving the powers of the Postmaster-General both in the heads of agreement of 1892 and the perfected agreement of 1896?—Of course the agreement is drawn legally by Sir Robert Hunter, who is, very properly, extremely sensitive about the privileges of the Post Office, but I am not standing on that agreement as it was drawn with the distinct pledges from the authors to me.

Then really the agreement before the public must not be read in its literal sense?—I don't know how the public may read it, but I read in the sense which Mr. Goschen and Sir James Fergusson and Mr. Arnold Morley, not in a casual talk, but over and over again, suggested was the condition on which we were to enter upon the new position by abrogating the powers which would have made us invulnerable against the Post Office. The heads of agreement were signed in 1892, but the agreement itself, in consequence of this very question of whether we would, or would not go in on the mere

abstract interpretation of that agreement, took four years to perfect, and it was during the negotiations which extended over that period that these assurances were made over and over again. We would not have concurred in the policy of the Government but upon that pledge or promise. Constructively, it amounted almost to a pledge in writing from Mr. Arnold Morley. What I rely upon—and what all men of business and honourable men would rely upon—was the assurances from the highest quarter, which assurances were calculated and intended to allay my alarms, because I was the negotiator.

Assurances which were not written and which do in fact alter the terms of the agreement?—No.

Was Mr. Lamb present at these interviews?—At some of them.

Was he present at the one with Mr. Goschen?—Yes, I think he must have been.

Have you read Mr. Lamb's evidence before the committee of 1892, in which he said that the right of the Post Office to compete with the company had been distinctly reserved?—So it is, but the pledges of those who negotiated the agreement on the part of the State were that it was not to be too literally construed.

Before the committee of 1895, Mr. Lamb said that there was no doubt that the Post Office, without any breach of honour, contract, or faith, could grant additional licenses?—Do you agree with Mr. Lamb?—I have my doubts as to whether the Post Office could do it without a breach of honour.

You were examined before the committee of 1895 and said, on the question whether there was any honourable agreement that the Post Office should not grant competing licenses:—"The Post Office are absolutely free. I would go further and say that there never was the slightest suggestion, directly or indirectly, of any such concession on the part of the Post Office, or any promise or pledge to lock up their discretion. On the contrary, from beginning to end, it was strictly reserved, and therefore, they are quite free."—WITNESS—That is very natural and they did reserve it.

But they reserved the discretion, according to you, under a verbal pledge not to exercise it?—They reserved the discretion with a positive promise that it should only be exercised in our case in certain circumstances. They have the discretion now. If they choose, they can begin to-morrow in any town, or give a new license. But if they did so, they would be breaking the pledges made by Mr. Goschen and others as to the circumstances in which the discretion should be exercised.

There is absolutely no record of such highly important promises which alter the whole effect of the agreement?—I do not see that it alters it one bit. I do not think you approach the thing from quite the right point of view. What was the position of the parties to the agreement at that moment?—We were not seeking any favours from the Post Office. We were quite satisfied with our position. We brought this enterprise into being, we ran enormous risks, and we had spent millions of money. I wonder that it has not struck anyone that we were nothing but the agents of the Government in carrying out and maintaining their monopoly. We were deprived of the benefits of our invention by a legal decision in respect of what the Post Office monopoly covered. We were the agents who then, and probably now, know more about the difficulties and possibilities of the business than anyone else. It was put to us, "will you incur these conditions for reasons of public policy?" We claim to be a branch of the Post Office, and what were we to do? I consulted my directors, and they were not at all so keen to abrogate the enormous powers which they had against any competitors; but it was felt that, as agents of the Post Office, they were bound to submit their views to the dominating department, and particularly when the matter was put to us by the heads of the Treasury. Mr. Goschen was good enough to enlarge a good deal upon it, and we were to co-operate with the policy of the Department as far as we could. We were to develop the local exchanges, while the Government were satisfied to take possession of our trunk wires, and spend money in perfecting the trunk communications. What came up from time to time was the effect of the telephones upon the public revenue, and whether it was wise to popularise the telephones at a great loss and at the risk of destroying the telegraphs.

Assuming your position of partnership with the Post Office, and that the Post Office or its licensees cannot compete with you, do you claim a perfect right to compete against the Post Office in every area, even the new ones?—We were in possession of the whole of the country, and it was a question how much we were to give up in support of this policy.

There is a large part of the country not divided into areas now. If the Post Office created an area there, for its own purposes, would you have a right to compete?—I think not.

Would you be in a position to refuse to connect your subscribers with the new area by the trunk wires?—No; any competitor can from any area call for any subscriber on our system.

Are you authorised to compete in such a case under the agreement?—I should not think so, without the consent of the Post Office.

The CHAIRMAN said he would ask Sir Robert Hunter what his opinion was on the question.

Sir ROBERT HUNTER said his view was that if the Postmaster-General constructed an exchange area in order to connect it by the trunk wires with one of the other areas, so as to put it in communication with the National Telephone Company's subscribers, the company would have a right to transact business in that new area.

The CHAIRMAN (to Mr. Forbes): There is no understanding between the Post Office and the National Telephone Company that the company shall not exercise its rights as to competition?—Not at all; there is no limitation of the powers which we now possess. Beyond those areas we cannot go into any other area without the consent of the Postmaster-General.

Apart from the question of competition, would you put such an area as I have suggested in connection with your subscribers by means of the trunk wires?—On conditions; if the Post Office in that area wished to get the access for their subscribers to the subscribers of our area they should pay toll to us for performing one of the terminal services. That is my view of the agreement, but if the solicitor to the Post Office says that we could compete, I do not wish to waive our legal rights now.

Did you hear Mr. Preece say that if the Post Office were given a free hand he would be perfectly willing to compete with you?—We do not fear the Post Office competition, but the result would be that we should between us make a mess of it. We should make the service chaotic, and we should throw away vast sums of money. We were always willing to do whatever the Post Office wanted, but they had no stable policy, and we never knew what they wanted. They could never make up their mind as to what they did want.

Then you say it is a great public inconvenience that there should be two rival schemes in the same area?—Yes.

But the public convenience has not prevented you from competing with the Post Office?—No; for the reason that they were in possession of the trunk wires. It is to the advantage of the Post Office that we should compete with them. I have no hesitation in saying that the working out of the agreement has done a vast deal more for the telephonic communication of the country and for the interests of the country than the Post Office could have done by themselves.

You say that it was for the benefit of the Post Office and the National Company alike that you should enter and compete with them in these areas?—Yes.

I understand that just as you are prepared to say it was a good thing that you should compete in these areas with the Post Office, so you would not object to the experiment being made of a big municipality competing with you?—I object to it altogether.

In 1895 you said you should like to see the experiment tried of a big corporation competing with you on even terms?—I think competition, whether it is with the Post Office or a municipality, is an extremely bad thing for the community. It is wasteful, chaotic, and ought not to be done.

Have you ever agreed, in the public interest, that where you and the Post Office are in competition the two exchanges should be connected?—I don't think it has ever been suggested. If it had, we should have been prepared to bargain. We will perform the Post Office terminal service if we are paid for it. We will agree to-morrow on terms to put the Post Office subscribers on to our subscribers. This policy must be limited to the Post Office, and not to be extended to their licensees.

Assuming that licenses are granted to municipalities, you would ask, and I think very fairly, that they should compete with you on equal terms?—It would be monstrous that any competitor should be put on more favourable terms, especially when the man in possession in that area has developed the business and has overcome all the risks and difficulties.

Would it be unfair to grant municipalities licenses extending beyond 1900, say, for a period of 20 years, such as you would have enjoyed on licenses granted in 1891?—I think it would be unfair. Many of the years of our licenses have been spent in developing the system and in finding out the best methods.

Why should not a municipality be granted a license extending beyond 1911?—All licenses are granted on the principle that some day they will be terminated. Now, among the causes of the high cost of the telephone services are the Post Office royalties and the necessary provision for redemption of capital. Further, there is the enormous charge of expansion. Between now and 1911 the company will have to spend about £5,000,000 for expansion. The municipality would have the advantage of starting where we have now arrived by the expenditure of much capital. All the difficulty in the Glasgow service arises from the contumacy of the corporation.

But you have the advantages which neither the Post Office nor the municipality could claim. You have the right to give preferences?—We have the right to conduct our business in our own interest. But, though we have the power, we do not give preferences. All assertions of that sort are quite unfounded and unjust. There has been a great deal of suggestion, but not a shred of evidence. Of course, we cannot govern the zeal of thousands of agents, but the board of directors have no knowledge whatever of these preferences, which are a regular bogey.

But Mr. Lamb and Mr. Preece say that it is the giving of these preferences which had enabled the company to drive out the Post Office?—That is not so. I am surprised at gentlemen so eminent and competent falling into such an error.

Will you enter into an engagement not to give preferences?—On conditions, if I get some equivalent. Wherever the Post Office and the company agree to exchange communications between their respective subscribers, I will undertake that there shall not be preferences of any kind. I would give up the right to give preferences for an undertaking that no licenses should be granted extending beyond 1911.

The company is not obliged to serve everybody, and the Post Office is, and the municipality would be?—The company would undertake to supply everyone who applied, on conditions. We cannot put our valuable instruments into places where they might be sold or pawned. But we would undertake to serve all applicants as to whose respectability and substance we were satisfied. It would be folly to refuse a reputable customer.

Then as to wayleaves above ground. Is it not the fact that you refuse to serve even substantial persons unless they allow you to carry your wires over their roofs?—That is in our contract. But even the Post Office would only be bound to give service to the extent of their capacity; and if they could not get wayleaves, they would not serve. The condition we impose is the same for all subscribers.

The Post Office have not the power to make such a condition?—I am sorry for the Post Office if they have not. Without it the business would be impracticable.

You have another advantage over a municipality. Having so

many exchange areas, you could make them bear the expense of a keen competition with the municipality?—I am much obliged to you for the suggestion.

In reply to further questions from the Chairman, Mr. Forbes said he did not think it was reasonable from the point of view of the development and efficiency of the telephone service that the municipality should have the power of veto in regard to the streets. There were 133,498 telephones in use belonging to the company, and the cost per instrument had been £50 14s. 8d. The company had spent £2,027,000 in the most legitimate fashion, without extravagance or want of skill. There was no justification for the suggestion that the undertaking could be brought up for £2,500,000. After 1904, they would not spend another farthing in development.

The Committee then adjourned.

At the resumed sitting of the Committee on Tuesday last—Mr. Hanbury presiding—the cross-examination of Mr. J. S. Forbes, the chairman of the National Telephone Company, was resumed.

Replying to Mr. Bartley, Mr. Forbes said that they would not have entered into the 1892 agreement unless they had received an assurance from the then Postmaster-General that he would consider any reasonable proposition that was made to him with regard to the extension of areas.

Was there anything else you considered important in that verbal understanding?—Yes; competition in areas was equally as important.

Was there any verbal understanding about that—did Sir James Fergusson give you a verbal assurance that there should be no competition in your areas?—The contract we were about to enter into turned upon a policy which was enunciated by Mr. Goschen in the House of Commons on Dr. Cameron's motion, and the conversations I had with Mr. Goschen turned upon two things—what interpretation was I to put upon the conditions which you foreshadowed in your speech in the House of Commons. He made a speech in the House, which speech he corrected before it appeared in *Hansard*. The result of the conversations was that it was clearly understood that if the National Company were not in any area, and the people there wished to have telephonic communication, if the National Telephone Company did not supply it, it would be competent for the Postmaster-General himself to supply, or to license somebody else. The second stipulation was that the Postmaster-General would not give a license to areas in which the company was already established if it conducted its business with reasonable efficiency.

In areas where your company was carrying out the work satisfactorily the Postmaster-General gave you a verbal understanding that there would be no competition?—Yes; and Mr. Goschen was present, I think, at some of the interviews which I had from time to time with Sir James Fergusson. There was always a third party present.

Do you mean to say that such an important consideration as that there should be no competition in your areas was not written in any way?—It was spoken in the House of Commons.

Is there anything about it in the agreement of 1892?—No, nothing at all. The Post Office retain their absolute discretion as to giving licenses.

You consider that Mr. Goschen's speech in the House of Commons formed part of the contract you entered into?—Yes.

You don't agree with Mr. Lamb that the areas are the only subject of this verbal agreement?—The Postmaster-General knew as well as Mr. Goschen that we should not have signed the agreement if it had not been for these understandings. The question of areas was a very important consideration, but it was not the only subject.

Do you think that that verbal agreement or arrangement is still binding on the Post Office?—Yes.

It remains in this way, that one essential part of this agreement simply remains in the memory of one of the contracting parties, and there is no written memorandum about it at all?—It is burnt into my memory; and if Mr. Goschen is called, I should think he would confirm what I say.

Your position is, that the agreement was entered into with two most important conditions omitted, which were settled between you and Sir James Fergusson, and which were merely verbal?—That is so. If the Treasury minute, which is based upon that agreement, is read not literally, or with the narrowness of a lawyer, but as men of honour, and men of business would read it, I say anything which is at all evasive of the spirit of the agreement would be a wrong to the National Telephone Company.

But do you think it usual for men of business and men of honour to enter into an agreement distinctly settled, and then to enter into a verbal agreement outside the written one?—My position is that there is no verbal agreement outside the written one; there is an understanding as to the manner in which the agreement should be carried out. I myself, in connection with railway and other matters, have over and over again revised agreements where it was shown that it was impossible for them to be carried out with equity if the hard and fast letter of the contract was adhered to.

Then in this matter you are to be the judge?—Oh no; I am here to be judged, and I feel sure we shall be judged in a spirit of equity and in a manner which observes the spirit of the agreement, and not the letter only.

You wish the Committee to understand that the distinct statement in the formal agreement is one, the letter of which you are not bound by?—We are bound by it if the Government of the day disregard the antecedents and practice of their predecessors, but I don't think they will.

Replying to Mr. Cawley, Mr. Forbes said it would seem from the evidence that Sir Robert Hunter had given quite a different opinion as to the effect of the understanding arrived at. In that case, he could only appeal to Cæsar, who would come before the Committee next Thursday—he referred to Mr Goschen.

You say that the company was in an invulnerable position before they allowed the Government to take over the trunk lines?—Yes.

You sold the Government the trunk lines, and they gave you money for them, and in addition they gave you facilities in the way of wayleaves and areas?—Yes, but we should not have agreed to the sale but for the assurances I have told you of.

But you have made an excellent bargain, because although the Government did not agree that there should be no competition, as a matter of fact you have been free from competition for seven years?—As to the bargain being so excellent a one, I have not made up my mind that it can be so described. Perhaps you have not examined it, I have.

But you have had a monopoly for seven years?—That is so. From one point of view the bargain is a reasonably fair one in regard to its termination, but it could be made extremely unreasonable by some action of the Government in the meantime, and until I know what they are going to do I cannot say whether the bargain is a good one or a bad one for us.

It has proved an excellent bargain so far, because you have been able to pay good interest on an enormous capital, and to put by large reserves, and the shares of the National Telephone Company now stand, I believe, at a very high premium in the market?—That is only what I may call the popular and ignorant way of putting the matter. It is really not true.

Mr. Cawley then examined the witness at some length as to the reason which led the National Company to buy up the Manchester Company, and in reply, Mr. Forbes said that that company was bought up along with others, in pursuance of the arrangements they came to with the Post Office to buy up all the licenses. The Manchester Company was in operation about 3½ years, and during its existence it spent about £60,000 and never realised one farthing of profit.

In your evidence in 1895 you admitted that competition had the effect of keeping your company up to the mark?—Yes, but it also has the effect of combination.

Should I be right in saying that competition promotes cheapness and efficiency?—Competition applied to some things is wholesome, to others it is just the reverse. In the case of so delicate and difficult a service as the telephone, competition would not result in increased efficiency.

By Sir James Woodhouse: He objected to the granting of licenses to municipalities on two broad grounds—first, that it would be inconsistent with the equity or understanding arrived at between the company and the Post Office; and, secondly, because it would admit of competition. It would certainly be a violation of the spirit of the agreement were such licenses granted. He did not attempt to get a stipulation in the heads of the agreement, or in the subsequent agreement, that the Post Office should not grant competing licenses either to companies or municipalities, for the simple reason that he knew it would be impossible.

Mr. Arnold Morley, who was Postmaster-General from 1892 to 1895, was next called, and in reply to the Chairman, said he was perfectly conversant with the Treasury minute, the heads of agreement signed by Sir James Fergusson, and with the perfected agreement of 1896.

While you were Postmaster-General, had you any reason for reading the heads of the agreement in any other than their strict meaning?—No. I had known there had been negotiations and conversations between my predecessors and the Chancellor of the Exchequer of the late Government and the National Telephone Company, but I understood there was nothing except a general assurance that the object of the Post Office would be to give effect to the agreement, and to make it as successful as possible in the interests of the public.

How did you get that information?—From the reports of the conversations and negotiations that had taken place. I was fully informed by the Post Office officials of what had taken place.

Did you get it direct from Sir James Fergusson?—No; I had no communication from him.

Or from the Chancellor of the Exchequer, Mr. Goschen?—No.

What exactly was the impression left on your mind as to how far the agreement represented everything that was binding on the Post Office?—I understood it represented everything binding on the Post Office, both legally and in honour. There had been the general assurance, which I gave myself on several occasions, that the Department and I, as head of the Department, would do their best to carry out the agreement in the interests of the public, and make it a success.

You have heard what Mr. Forbes has said as to some verbal understanding which was to modify the actual terms of the agreement?—Yes; I heard nothing of that during the three years I was at the Post Office. I had conversations with Mr. Forbes, and he tried—I think very fairly—to get concessions from the Post Office with regard to competition and areas, but there was no mention made of any undertaking or obligation.

You say Mr. Forbes tried to get concessions. Did he, as a matter of fact, get them?—No; I gave no concessions, beyond the general assurance that the policy of the Department would be to make the agreement, which, in my opinion, was not altogether the best agreement that might have been made—a success, because I recognised it as a final agreement.

Is it not a fact that the clause relating to competition in the heads of agreement signed by Sir James Fergusson is almost word for word the same as the clause in the completed agreement of 1896?—I could not say whether they are the same word for word, but they are in spirit certainly, and they left the Department absolutely unhampered, absolutely free.

During the whole three years you were at the Post Office you understood that these agreements were to be read in their legal sense—that there was no honourable understanding that they were

to be read in any other sense?—Certainly, that was my impression, and I heard nothing to the contrary.

Would you have felt free if you had wished to give a license to a competing company?—I should have felt absolutely free in any case, although my own opinion was very strongly against competition, unless the Post Office was forced to it in the public interests.

That is your private opinion, but as a public official, you would have felt that there was nothing binding you in law or honour to prevent you granting a competing license?—Certainly not? and I think Mr. Forbes admitted that before the Committee of 1895

Did you feel perfectly free, too, to do as you chose with regard to areas?—Yes, both as regards the creation of new areas and the extension of existing areas.

There was no understanding binding you to use your discretion in any sense favourable to the company?—No, except the general assurance, which I understood had been given, and which I gave myself, that we should act in a reasonable spirit, and with the object of making the policy of the agreement a success.

In reply to other questions, the Witness stated that he left Mr. Lamb a free hand in working out the details of the general scheme as to areas, subject, however, to the observance of the principles embodied in the memorandum of which he had approved. He thought the Post Office was the only body which could give a really effective telephone service to the whole country. Personally, he was opposed to giving municipalities the power to work the telephone. That power should be reserved, and should be exercised only in the case of the National Company not giving a service which was efficient and fairly cheap. If they had two separate systems competing in the same area they must have waste and great inconvenience to the telephone subscribers, half of whom would be under one system and half under the other system.

The Committee then adjourned.

LONDON COUNTY COUNCIL.

At the weekly meeting on Tuesday the Council resolved to lend the Hampstead Vestry £39,980 for extensions of buildings and additional electric lighting plant, and £23,840 to the Vestry of Islington for mains, conduits, arc lamps, and transformers.

The Shoreditch Vestry made an application for a loan of £20,539 for electric lighting purposes. With regard to this, the Finance Committee stated: "Of the amount applied for, £17,029 is stated to be for engineering works, made up as follows: £4,984 for additional expenditure on boilers, £9,068 for additional mains, £1,312 for motor transformers, &c., and £1,665 for sundry expenditure, including £1,000 for steam mains, pumps, &c. The Council's engineer reports that sufficient information has not yet been given to justify the outlay of £4,984 for boilers, and that it appears probable that part of this outlay at least should be charged against the dust destructor portion of the work, and that of the £1,665 only £300 of the item of £1,000 for sundries appears properly chargeable to the electric lighting outlay, and that for the present the loan should be limited to the sum of £11,345." The Committee concurred in this view, and the Council resolved to restrict the loan to £11,340.

Underground Telephone Pipes.

In May last the Council decided to require the National Telephone Company to enter into an agreement embodying certain conditions with regard to the underground works which have been executed by the company under the conditional consents given by the Council on various occasions. The agreement will shortly be ready for completion, and the Highways Committee asked that the seal of the Council should be affixed to the agreement as soon as ready.

The Southwark Provisional Order.

The Highways Committee reminded the Council that last February disapproval was expressed of certain works proposed to be carried out by the County of London and Brush Provincial Electric Lighting Company under its Southwark order, 1892. The Council took that course in consequence of the Vestry of St. George-the-Martyr having stated that it refused sanction to the works, and had applied to the Board of Trade for the revocation of the order, having regard to the default of the company in not having complied with the requirements of the order, which was granted five years ago, that the mains within a certain defined area should be laid within a specified time. The Vestry further stated that it had under consideration the question whether it should itself undertake the supply of electric current in the parish. The company subsequently served a fresh notice of intention to execute the works referred to, and the Council, for the reason above stated, again disapproved them. The company appealed to the Board of Trade against the decision of the Council and of the local authority, and the appeal was heard before Major Cardew at the offices of the Board. The Board expressed a desire to hear any representations which the Council might wish to make with regard to the matter, and the chairman of the Highways Committee (Mr. Benn) and Mr. Thornton attended, and supported the views of the local authority.

The Board of Trade gave its award on July 11th, allowing the appeal, and approving the works, subject to the following conditions: "1. That the undertakers give a written undertaking to the Board of Trade that they will at once commence and diligently proceed with the execution of the said works, and that if within 18 months from the date of this order the undertakers are unable to give a supply of energy in the parish of St. George-the-Martyr, Southwark, from any generating station belonging to them, and existing at the expiration of the said period of 18 months, they will at once proceed to erect within the said parish, or within some adjoining district, a generating station, from which a proper and sufficient supply of energy in the said parish can be given. 2. That the undertakers, without delay, furnish the local authority with a correct plan of the said works, together with details of the size and situation of the proposed transformer chambers and street boxes. 3. That this order shall not be held to fix the exact position of any transformer chamber, but that in case of any difference arising between the local authority or the County Council and the undertakers with regard to the position of any transformer chamber, the matter shall be determined by an inspecting officer appointed for that purpose by the Board of Trade."

Commenting upon the question, the Highways Committee stated that safeguarding conditions of considerable importance have been secured through the action of the Council and the Vestry.

THE CHEMISTRY OF BOILER WATERS.

It is probable that the question of the impurity of water for steam purposes is about as important in America as it is here. The same impurities seem to occur in about the same proportions, and as with ourselves, there are many supposed cures. A recent paper by Mr. H. Leffman lays a good deal of stress upon the corrosion of boilers by means of dissolved oxygen. Oxygen is so much more soluble than nitrogen in water, that the air taken up by water is not true air; it is made up of a larger than proper ratio of oxygen. When heated, the oxygen is given off by the water, and its chemical activity is increased. We have come to think that as oxygen attacks boiler plates, and does so chiefly near the point of feed entrance, it would be desirable to free it of oxygen before it enters the boiler, by passing it through a receiver filled with iron turnings. These present so much surface to the water that they would readily absorb any oxygen. They would also destroy any acidity, and particularly remove just such corrosive agents as attack iron plates.

Nitrates are corrosive salts, and magnesium chloride being an unstable salt, is apt to give rise to free hydrochloric acid. This seems to be what occurs in the water of the Thames below London Bridge, and causes such serious corrosion. Some waters are very difficult to treat in a way to deposit their scale-forming ingredients. For example, it is possible to destroy calcium sulphate by converting it into calcium carbonate, which may be deposited, but the result of using soda for this purpose is to leave sodium sulphate in solution. Though a very soluble salt, it is not infinitely soluble, and rapidly concentrates with dangerous results to the plates. We cannot state exactly the effect of sodium sulphate upon water, but it is certain that the effect of sodium carbonate is to destroy the cooling effect of water and incur risk of overheating.

The modern tendency to use sodium fluoride and trisodium phosphate to convert the calcium and magnesium compounds into flocculent precipitates, as described by Mr. Baker, produces highly soluble and non-corrosive salts of sodium.

It is against the undue concentration of these that engineers should specially guard themselves. From the chalk waters of the south of England, the scale produced is a carbonate scale. This can be best prevented by the use of lime before the water enters the boiler. Very badly scaled boilers when the scale is carbonate can be cleaned by dilute hydrochloric acid. The use of this is only to be carefully attempted. It is possible no harm may accrue to the boiler until the scale has disappeared, but this requires watching.

As regards soda salts in solution, we may add that the boiler insurance companies do not care now to insure boilers at above 15 lbs. pressure which are used for the concentration of soda liquor. In a letter now before us, the chief engineer of one of the companies states that in such boilers unexpected fractures and collapses are found to occur in a manner not yet satisfactorily explained. Undoubtedly soda ash has these effects, and other soda salts must be guarded against in the absence of proof to the contrary.

REVIEWS.

Acetylene Gas, Its Nature, Properties, and Uses; also Calcium Carbide, Its Composition, Properties, and Method of Manufacture. By G. F. Thompson. Liverpool: Published by the Author, Lombard Chambers Bixteth, Street. 1898. 3s. 6d. Post free, 3s. 9d.

This little work originated in a lecture delivered by the author before the Liverpool Polytechnic Society, the primary object of which was to make known the properties of acetylene, and by pointing out its alleged advantages in contradistinction to its alleged dangerous character, to remove the suspicion attaching to it, and to allay the fears which have been aroused by the occurrence of accidents through its agency.

This is not quite what Mr. Thompson says in the first

paragraph of his preface, for in this he makes it perfectly clear to the reader that he is a partisan and posing as though he held a brief for this new illuminant. On perusing the book, which is brightly, if, at times, loosely written, the average reader will probably fail to be convinced by Mr. Thompson's mere statements that acetylene possesses the harmless character which he attributes to it. We have endeavoured to bring to the study of this little book an unbiassed mind, and to set aside any feelings that might, perhaps, arise in us regarding an illuminant which professes to be so much superior to everything else as acetylene does. We have looked, therefore, through the various chapters for any proof that acetylene is so harmless as it is represented to be, but we have sought in vain. Although the author refers to the alleged poisonous character of the gas, its products of combustion, and remarks upon the highly endothermic character of the compound, he does not attempt to disprove the statements which have been made respecting it, nor does he give any account or explanation of the numerous accidents which have taken place. On the other hand, he emphasises over and over again the harmlessness of the gas, and complains of the various misstatements which have been made respecting it, though he does not pillory these so-called statements and show upon what grounds they are based, nor, as we have said before, does he give any account whatever of the accidents which have taken place, nor show how they might have been prevented. The author rather treats the reader as one would be disposed to treat a child when teaching him to swim, and we fancy him saying again and again, "It's all right; there is no danger." But this would scarcely do for a book, even of such modest pretensions as the one which we have passed in review. We expect something more than the author's reiterated assurances, and we think that he might have been at some pains to review the literature of the subject and to answer the many charges which have been made against acetylene, even if he prefer to gloss over the accidents which have happened, as being the unfortunate but necessary accompaniments of a new thing.

It is possible that Mr. Thompson has adhered too closely to his lecture style in this book, and we think he has; but he certainly ought to dissociate book style from lecture style; at any rate, he ought to have recognised that that which would pass very well in a popular lecture, will hardly be the sort of pabulum for a book, statements in which would be carefully weighed and reflected upon by the intelligent reader.

We note with some surprise an entire absence of references to patent literature. It seems to us that in dealing with such a new subject as illumination by means of acetylene, patent literature should have been generously drawn upon, and a list of patents, even if unaccompanied by short abstracts of them, should have been considered essential. We note also a great dearth of references; but Mr. Thompson must know that the value of statements is enhanced if the writer can give his authorities. The literature on this subject is necessarily rather scanty, but many books have been published in France, at any rate, which should have been studied and referred to by the author before he ventured into print. Possibly he *has* studied them; if so, due acknowledgment should be made, and a list of the literature of the subject should have been appended to the work.

The book is too small for detailed review, and also there are many points upon which we should like to join issue with the writer, but we must refrain from want of space.

On the whole, this little work is one of the best contributions to the subject which we have yet read, and it cannot fail to be of use to those whose attention is being attracted to it. It strikes us, however, as being rather a skeleton book, and if only Mr. Thompson will, in a new edition, put flesh upon its bones, and then clothe it decorously and suitably, we think it will be a much more useful contribution to our knowledge than in its present form it is. Among other things, we would suggest that illustrations should be given, showing the different forms of burners in which the gas is consumed, the apparatus used in producing the calcium carbide, &c. The book is worth obtaining, and those who are interested in illumination will, whether their tendencies lean towards electricity or gas, do well to study it. We certainly cannot class it amongst those useless books which nobody wants to read, much less purchase.

Steam Boiler Construction. By Walter S. Hutton. London: Crosby, Lockwood & Co. 1898.

We do not know the author of this book, nor do we know anything of his bringing up, training, or experience, but he has certainly written one of the best, if not the best, books on boilers that has ever been published. Whether from his own experience or by reason of a singular ability for collecting information of the right kind and putting it in a simple and accessible form, the author deserves the utmost credit. The title is somewhat of a misnomer. It should have been extended to include working, for the book is an excellent guide on everything connected with the treatment of boilers, the handling of furnaces, and the qualities and capacities of fuels. The first section of the six into which the volume is divided deals with heat and fuels generally, including non-conducting materials, &c. The tables are good, and the verbal definitions of terms such as specific heat, latent heat, &c., are clear and concise, and suited to the practical man, and even the non-technical layman of intelligence who can comprehend English.

There is no attempt at any finical definition; the language is simple and to the point. But it is in the selection of facts and figures that the author is so commendably good. The subsequent sections of the book include chimneys and data as to water, heating surface and particulars as to furnaces and shells, strengths of materials and structural details, descriptions of types of boilers, boiler setting, &c., and, finally, general details, as safety valves, injectors, &c., evaporation, explosions, &c.

Taking at random the question of stoking with reference to draught, grate area, fire thickness, we turn to the pages which deal with these subjects, and find a clear recognition that draught, size of fuel and thickness of fire, are closely interdependent factors. We find it clearly stated why a thin fire is apt to be wasteful, if not in the care of first-class stoking, and in this one respect of stoking a reader will learn how important a matter stoking may be, and how, say for purposes of a fictitious test, a stoker may purposely do well or ill, and secure widely divergent results. We need not expand our remarks on these points; sufficient to say that Mr. Hutton is a safe and accurate guide. Throughout the book occasional brief sentences are met with, which show to the practical man that the author knows his subject. Commercially, also, the book is valuable for its information on the cost of evaporation, with various fuels and waste substances, and there is much other valuable commercial information, some a little aside of the title, perhaps, but closely connected, and by no means out of place. Undoubtedly this is the standard book on steam practice, so far as steam generation is concerned, and if he never does anything more, the author will have earned the thanks of the profession for what he has done in getting out this work.

Industrial Electricity. Translated and adapted from the French of Henry de Graffigny, and edited by A. G. Elliott, B.Sc. London: Whittaker & Co., 2, White Hart Street, Paternoster Square.

This book is the first of a series on electro-mechanics which the editor intends bringing out. The plea for the translation appears to be that in the original French many thousands of the work have been sold. The book is undoubtedly a reliable one, though on page 13 we meet with the statement that the ohm is the resistance of a column of mercury 106 centimetres long and 1 square millimetre in cross-section; it seems curious that the editor should not give the precise length of the column instead of the approximation only. On page 43 it is stated that the Post Office standard cell is simply a Daniell cell in an ebonite box; it may be mentioned that this form of standard has recently been abandoned, and a form of dry cell is now employed for the purpose. The Callaud cell, by the way, is called the Calland cell in error. On page 148, 200 words per minute is spoken of as an enormous speed for telegraph working, a speed which "will probably seem very slow 50 years hence." As a matter of fact, 600 words is now, and has been for some time, the highest Wheatstone automatic speed. The book cannot be considered as an elementary one; indeed, it would afford but very little information to those who had not previously made a study

of electrical phenomena. Such matter as is given, however, is sound and well put together. The actual chapters are as follows:—I., Nature of Electricity; II., Electric Units; III., Magnetism and Induction; IV., Practical Measurement of Electrical Quantities; V., Chemical Generation of Electricity; VI., Accumulators; VII., Dynamo-Electric Machinery; VIII., Electric Light; IX., Electricity as a Motive Power; X., Electro-Chemistry and Electro-Plating; XI., Bells and Telephones; XII., Telegraphs.

MAGNETIC SUSCEPTIBILITY OF MATERIALS.

In the *Physical Review* (America), April, Mr. Albert P. Wills described a series of experiments to determine the magnetic susceptibility of various materials, the results obtained being as follows :—

Material.	$\kappa \times 10^6$	Observations.
Marble, 5 kinds ...	− ·603 to − ·940	
Aluminium... ...	+ 1·88	
Glass	− ·578	
Tin	+ ·354	Tin is known to be diamagnetic, and this value of κ for antimony is smaller than usual. Both samples were suspected of containing iron.
Antimony	− ·714	
Bismuth	− 12·25	
Sulphur	− ·765	
Ebonite	+ 1·08	
Paraffin	− ·577	
White wax	− ·560	
Shellac	− ·394	
Wood, 5 kinds ...	− ·16 to − ·51	The series of five values corresponded in order to the hardness; the hardest wood being most diamagnetic.

A series of observations were made on bismuth in fields ranging from H = 1,620 to H = 10,450, which seem to show that the value of κ does not vary with the strength of the field, and observations on white wax are said to give a similar result, though in this case no figures of it are given.

The measurements were made by weighing a slab of the material in a magnetic field, in the mode shown in the figure, the dimensions being such that the field could be treated as uniform all over the lower bounding surface of the slab, could be neglected along its upper edge where the slab was suspended, and was unchanged by the insertion of the slabs in the air-gap.

The formula used to state the connection between the vertical force on the slab and the magnetic susceptibility is

$$2\,F = A \cdot \kappa \cdot H^2,$$

where F is this force,

A is the area of the lower surface of the slab,

κ is the susceptibility of the material,

H is the strength of field at the lower edge.

An elaborate proof of the equation is given in the paper, but it may be shortly stated thus. To lower the slab through a short distance, $d\,y$, is equivalent to replacing the air in that space by the material under test. The energy represented by the magnetic induction in that space when occupied by air is $\frac{1}{8\,\pi} \cdot A \cdot d\,y \cdot H^2$, and when occupied by the material $\frac{\mu}{8\,\pi} \cdot A \cdot d\,y \cdot H^2$. The work done in lowering the slab is the difference of these quantities, *i.e.*,

$$F\,d\,y = \frac{\mu - 1}{8\,\pi} \cdot A \cdot d\,y \cdot H^2,$$

and

$$2\,F = A \cdot \kappa \cdot H^2.$$

The value of H was determined by weighing in the field a conducting frame identical in form with the bounding surface of the slabs carrying a known current.

The comparison between the mechanical forces on this conductor and the slabs of material is an excellent illustration of the equivalence of a current of any form to its equivalent magnetic shell. The details of arrangement and manipulation of these experiments offer many points of interest.

NEW PATENTS.—1898.

Compiled expressly for this journal by **W. P. Thompson & Co.** *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*

14,661. "Draw and joint or intersection boxes for electric wiring on the tubular system and the like." R. A. Douglas. Dated July 4th.

14,666. "Improvements in electrical fusible cut-outs." A. J. Howard. Dated July 4th.

14,694. "Improvements in and connected with electric arc lamps." E. Buchholtz and J. Taylor. Dated July 4th.

14,714. "Improvements in vacuum dielectrics, electrodes, and apparatus for the production of ozone." D. Martini. Dated July 4th.

14,715. "Improvements in tubular conduits for electric wiring." T. Taylor. Dated July 4th.

14,726. "Improvements in primary batteries." W. Rowbotham. Dated July 4th.

14,732. "Method for obtaining combined alternating and continuous currents and distributing the same for the electrical transmission of power, particularly for electrical traction." M. Deri. Dated July 4th. (*Complete.*)

14,761. "Improvements in electrical safety fuses or 'cut-outs.'" W. E. Langdon. Dated July 5th.

14,785. "An improved method of facilitating the coupling and uncoupling of alternating current dynamos." G. Dettmar. Dated July 5th.

14,793. "Improvements in insulators." The British Thomson-Houston Company, Limited. (B. Willard, United States.) Dated July 5th. (*Complete.*)

14,800. "Improvements in and relating to electrical heaters, rheostats, and the like having comminuted resistance for the electric current." R. van R. Sill. Dated July 5th. (*Complete.*)

14,809. "Improvements relating to electric accumulators or storage batteries, and to the manufacture of plates or electrodes therefor." W. H. Smith and W. Willis. Dated July 5th.

14,810. "Improvements in electric couplings." W. J. Davy. Dated July 5th.

14,826. "Improvements relating to electric railways." R. Belfield. (The Westinghouse Electric and Manufacturing Company, United States.) Dated July 5th.

14,835. "Improvements in electrical curative appliances." J. Gallegos. Dated July 6th.

14,839. "Electro-deposition of metals by high tension currents." E. Andreoli. Dated July 6th.

14,868. "Improvements in primary batteries." P. Stiens. Dated July 6th.

14,907. "An improved arc lamp with magnetic carbon movement." F. Klostermann. Dated July 6th. (Date applied for under Patents, &c., Act 1883, Sec. 103, January 31, 1898, being date of application in France.) (*Complete.*)

14,909. "Improvements in electric conduits." J. Peschek. Dated July 6th.

14,934. "Improvements in junction boxes and like fittings for electrical wiring." G. A. Clark, W. McAulay, and J. A. McLaren. Dated July 7th.

14,947. "Improvements in apparatus for telegraphing without wires." W. J. Brooks. Dated July 7th.

14,953. "Electric sounding apparatus." H. E. Walter. Dated July 7th.

14,958. "Improvements in electric motors and dynamo-electric generators." F. H. Varley. Dated July 7th.

14,959. "Switch and contact apparatus for the cars of electrical railways and tramways." Siemens Brothers & Company, Limited. (Siemens and Halske Aktien-Gesellschaft, Germany.) Dated July 7th. (*Complete.*)

14,983. "Improved means of making connection with electric cables." R. J. Hatton and W. T. Henley's Telegraph Works Company, Limited. Dated July 7th.

15,003. "An improved electric switch." G. Hill. Dated July 8th.

15,028. "Improvements in the manufacture of electrodes." H. J. Haddan. (C. Francke, Germany.) Dated July 8th. (*Complete.*)

15,032. "Improvements relating to the fixing of electric wires or cables." S. W. Mitchell. Dated July 8th.

15,040. "Improvements in automatic circuit breakers." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) Dated July 8th. (*Complete.*)

14,041. "Improvements in circuit breakers." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) Dated July 8th. (*Complete.*)

15,082. "Improvements in electric telegraphs for ships and for other purposes." Eversheds & Vignoles, Limited, and S. Eversheds. Dated July 9th.

15,100. "Electrical influence machines." W. R. Pidgeon. Dated July 9th.

15,126. "Improvements in the manufacture and production of insulated electrical cables or conductors and apparatus to be employed in the said manufacture." A. H. Howard. Dated July 9th.

15,144. "An improved system of electric traction." N. Flechtenmacher. Dated July 9th. (*Complete.*)